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METHODS OF RECORDING EYE MOVEMENTS

BY

M. D. VERNON, M.A.

CAMBRIDGE

THE first attempt to record eye movements systematically was made by Javal[18] in 1878. He observed directly through a telescope the eyes of a subject while reading. The technique of direct observation was improved by Erdmann and Dodge[14], who, in 1898, studied, through a telescope placed behind the subject, the mirror image of his eye movements while reading. Though able to determine the general character of eye movements in reading, and to find approximately the number of movements and fixation pauses, these observers found that the movements were too rapid for it to be possible to measure accurately their duration. Since then direct methods of observation have been used to measure the slower movements of convergence and divergence, and torsion, and also voluntary eye movements; these methods are described in group (*c*) below. But other methods have been employed for the recording and measurement of the rapid, irregular, jerky or *saccadic** movements of the eyes during normal reading.

These indirect methods may be divided into two groups:

(*a*) Those which depend upon photography of the eye, of the reflection of light from the apex of the cornea, or of some small object attached to the cornea.

(*b*) Those which depend upon the attachment of a capsule or recording lever to the cornea or eyelid, the movements of which

* From the French word *saccade* (jerk).

may be recorded by direct tracing on a drum, or else photographically.

(*a*) Methods depending upon photography

(1) In 1902 G. M. Stratton[31] recorded photographically the movements made by the eye in following out the lines forming a diagram. As may be seen in Fig. 1, the recording camera C was placed directly in front of the subject. Light from an arc lamp A was reflected by the mirror M_1 on to the subject's cornea, and thence back to the slit of the camera; direct light was kept from falling on the subject by means of the screen S. The diagram to be studied was placed behind the subject; it was tilted down-

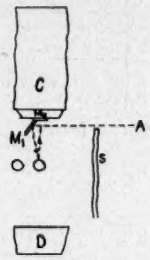

FIG. 1.

wards, and reflected to the subject by the upward-tilted mirror M_2 placed just above the camera slit. The experiment took place in darkness. A sensitive plate was exposed in the camera until the eye had followed out all the lines of the diagram.

This method was, of course, only useful for recording the number and path of the eye movements; no measurement of duration was made. Horizontal movements were slightly distorted in the record.

Later[32], the diagram was placed directly in front of the subject, and the camera and arc lamp at an angle of 60° on either side of the line of sight. Camera and lamp could be freely interchanged. There was no distortion of horizontal movements in this position, but a slight distortion of vertical ones.

(2) This method was improved upon by Dodge and Cline[6] in 1902, for measuring the angle velocity of horizontal eye movements in reading, and also for recording their path. A small piece of white cardboard, K (see Fig. 2), was illuminated by light from a window behind the subject; and the reflected image of K from the cornea, called the "bright spot," fell upon the horizontal slit of a recording camera C which could be moved round a perimeter

PP until focussed in the right position. The subject's head was fixated by means of a wooden chin-rest P; and he was instructed to look through a tube TT. The reading matter R was placed at

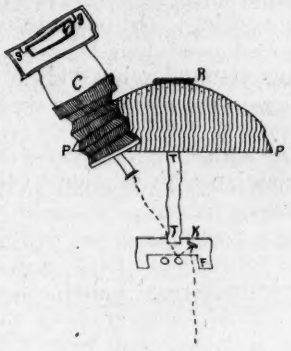

FIG. 2.

the centre of the circumference of the perimeter. But previously two knitting needles were stuck vertically into the perimeter at positions corresponding to the beginning and end of the lines of print. The subject was instructed to fixate first one and then the

FIG. 3.

other of these. A record of the reflection of K at these two standard positions of the eye was thus obtained, and subsequent movements could be referred to it.

The recording apparatus consisted of a sensitive plate carried on a framework V which fell vertically between brass grooves *gg* (see Figs. 2 and 3). To the base of the framework was attached the piston of an air pump R. The working of the pump caused

the framework to fall at a constant rate, which could be adjusted by means of suitable stoppages applied to the exit pipe. (In a later modification of this apparatus[9] an oil pump was substituted for the air pump; the oil, as it was ejected from the bottom, was returned to the top of the barrel by means of a pipe. This arrangement gave smoother working). In order to obtain a time record an electrically controlled pendulum D swung in front of the horizontal slit S; thus at regular intervals of time the light was prevented from falling on the plate and a dark mark appeared on the record.

Dearborn[6], working with a modification of this method, obtained much valuable information with relation to the reading process.

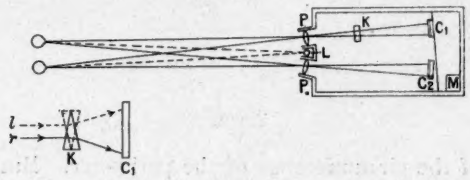

FIG. 4.

He used as his source of illumination an arc lamp, the rays of which were rendered parallel by intercepting lenses. He stated, however, that his experiments could be carried out as well in daylight as in a darkened room.

(3) J. Piltz[29] in 1904 used the photographic method for measuring the convergence and divergence of the pupil. He made his records upon a film rotated by clockwork about a vertical axis.

(4) E. B. Coburn[5] in 1905 invented a method for recording both the horizontal and vertical components of the eye movements upon moving photographic plates (see Fig. 4). Light from a lamp L fell upon the corneae of both eyes, and was reflected and focussed by the two lenses PP to fall on the photographic plates mounted on two carriers C_1 and C_2. These moved on smoothly-ground steel wheels along steel wires, C_1 horizontally and C_2 vertically. The wires were so inclined that the carriers did not interfere with one another. Their motion was produced by a clockwork motor M, and was quite regular; they were automatically stopped as soon as they had passed the focal points of the lenses.

In order to separate the records of the two eyes on the horizontally moving plate, two prisms were placed, in a vertical position, side by side at K, with the apex of one pointing upwards, and of the other downwards. Thus light from the left eye *l* was deflected upwards, and from the right eye *r* downwards on to the

plate at C_1. Before records were made the corneal images were focussed by manipulation of the lenses on to ground-glass screens placed in the carriers. The screens were then removed and replaced by the photographic plates.

This method appears to be more useful for recording the number and path of eye movements, for instance in pathological cases, than in reading, since, presumably, only the movements in reading a few lines of print could be recorded on one plate. It is possible that the duration of the movements could be measured by using a suitable time marker.

(5) In 1905, Judd, McAllister, and Steele[19] modified the method of Dodge and Cline by photographing the movements of a small flake of Chinese white paint, specially prepared, and attached to the cornea slightly below and on the nasal side of the pupil. They claimed that it was quite easily applied by holding the lower lid down, and then manipulating it to get the flake into the right position. If the flake was lost under the lid, it was dissolved and caused no harm; but once in position, it was not removed by ordinary winking. The movements of this white flake were said to represent more accurately the movements of the eye as a whole than the movements of the "bright spot," in the method of Dodge and Cline (but see [10] and [11]).

Direct or reflected sunlight, graduated by several thicknesses of blue glass to a comfortable intensity, was used as the source of illumination. The movements were recorded by means of a kinematographic camera driven, first by hand, later[20] by a motor. The film was drawn before the shutter of the camera in jerks, by means of a sprocket wheel the teeth of which fitted into the series of holes in the film. A semicircular rotating shutter moved between the lens of the camera and the film, and exposed to the light each section of the film as it came into place in front of the lens. A hard rubber wheel attached to the driving handle carried on its circumference a number of metal strips; during rotation they were brought into electric contact with two brass brushes, and the current thus made passed through a marker which traced on a kymograph. These contacts were synchronized with the film exposures; and the duration of the latter was measured by means of a time-marker also tracing on the kymograph. A double camera was afterwards constructed with two films; the exposure of one coincided with the closure of the other, and *vice versa*. Thus a continuous record was obtained. The camera was placed directly in front of the subject.

The head was fixed as far as possible by means of suitable head and teeth grips; but, as was found by other observers, head movements were not eliminated in this way. They were recorded by the reflection from small, brightly polished steel balls, or from

small concave mirrors, fastened to a wire spectacle frame. Later, a fixed point of reference independent of the head or the camera was always photographed; to this head movements could be related.

The determination of the path of the eye movements from the photographic record was an elaborate and lengthy process. For each section of the film separately the position of the eyes had to be referred to the points of reference on the spectacle frame, and their distance from them measured and recorded on a chart. This method was used extensively by these observers for measuring intra-fixation movements, movements made in viewing optical illusions, and movements of convergence and divergence. The

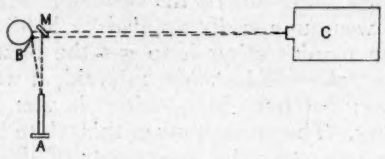

FIG. 5.

recording process, however, is too laborious for use without modification in connection with eye movements in reading.

(6) In 1907, Dodge[11] issued an account of a comparison of the accuracy of his method with that of Judd. Instead of a flake of white paint, however, he attached to the cornea a minute silver hemisphere mounted on a fragment of black tissue paper soaked in paraffin. As his source of illumination he substituted for daylight an alternating current arc lamp. This produced a series of discrete flashes, and hence obviated the use of Judd's kinematographic shutter, and also of a time signal, since the time of each exposure was known from the rate of alternation of the current. However, this rate did not remain altogether constant; a direct current lamp with a tuning-fork interrupter would probably be more accurate (see C. T. Gray's method).

The arrangement of the apparatus is shown in Fig. 5. Part of the beam from the lamp A was reflected from the side of the silver bead B to the camera C; the remainder was reflected from the partially silvered mirror M to the centre of the cornea, and then back to the camera. Thus a direct comparison of the records obtained by the two methods was possible. Dodge found that the movements of the bead were slightly larger in the record than those of the "bright spot," but they were more distorted, because the bead had of necessity to be placed to one side of the pupil that it might not impair vision. It was important, however, to ensure

that the light striking on the cornea and the light reflected from it should make equal angles with the sagittal plane; and that the "bright spot" should be confined to the central third of the cornea. In this work Dodge made use of a head and tooth rest similar to those used by Judd; and also of spectacles carrying small concave mirrors for recording head movements.

In recording vertical movements he employed Stratton's fixed plate method (this was, of course, possible with an alternating arc lamp in a darkened room).

(7) Another modification of Dodge's method was made by E. Koch[21] in 1908, for measuring the angle velocity of voluntary eye movements. Light from a Nernst lamp N (see Fig. 6) was reflected from the cornea through tubes TT, after having been

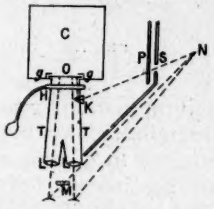

FIG. 6.

focussed by lenses LL, to a camera C, with shutter H, containing a film O which could be drawn vertically upwards by means of a kymograph between grooves *gg*. Light passing through a slit S was reflected by a totally reflecting prism K, fixed in an aperture of the tube, on to the film; a pendulum P, screened from the subject, swung in front of the slit, thus giving a time record on the film. The subject's head was fixated by means of a tooth rest. Two fixation marks were reflected to him by the small mirror M; he was required to sweep his eyes from one to the other. To record vertical eye movements, the camera was laid on its side, and the film moved horizontally.

(8) Another variant of this method was designed by O. Weiss[36] in 1911 for recording the blinking and rolling movements of the eyes and eyelids. In this case the eyes and lids were themselves photographed. The film was drawn from a roller B on to a roller A passing behind a slit S in a screen through which the image of the eye was focussed by means of a lens L (see Fig. 7). In front of the slit rotated a disc D in which were two openings in the shape of sectors. When one of these sectors coincided with the slit the movement of the film was stopped by one of the rollers R, moving about on axis C, which pressed against it. The movement of these

rollers was automatically synchronized with the rotation of the disc. Thus a series of sharp, almost instantaneous, photographs was obtained.

(9) The movements of the eye in reading were recorded in a similar way by C. T. Gray[16] in 1917, and G. T. Buswell[4] in 1920. A beam of light generated from a 400-watt. nitrogen-filled bulb,

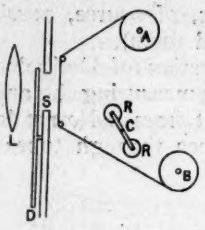

FIG. 7.

which gave a constant illumination, was rendered parallel by a double convex lens and reflected by two silvered glass mirrors on to the cornea, and thence to a camera containing a vertically moving film. The beam was interrupted by an electrically driven tuning-fork, vibrating at a rate of 50 or 25 per second; so that the film recorded the movements and fixation pauses of the eyes in a series of dots, each representing a duration of 1/50th or 1/25th

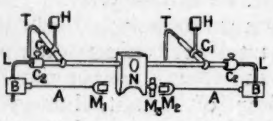

FIG. 8.

of a second. The camera was placed immediately in front of the subject; and the reading matter was projected, by means of a lantern and mirror, on to a plaster-of-Paris surface placed above the camera. Before beginning to read, the subject fixated successively two spots above the first and last letters of the line of print. These acted as points of reference on the record.

(10) In 1921, Dodge[12] invented a method of studying the compensatory movements of the eyes when the lids were closed. This method could also, however, be used for uniocular reading. He devised a species of spectacle frame (see Figs 8 and 9) of thin tubular steel with an adjustable hard rubber nose-piece N and two ear-pieces TT which could slide in and out of

the tubular supports SS to give correct adjustment. HH were hard rubber blocks which could be fixed by screws C_1, C_1, to fit closely to the subject's temples. Two arms LL could also slide in and out and be fixed by screws C_2C_2. These arms bore adjustable blocks of hard rubber BB to which were attached small cone bearings that carried light steel arms AA. These arms were forked at their further ends; and small concave mirrors

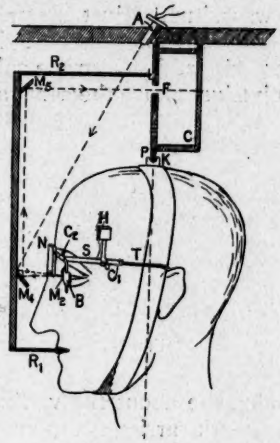

FIG. 9.

M_1M_2 swivelled about vertical axes, made of steel needles, which were carried by the forks.

This framework could be so adjusted to the subject's head that the mirrors M_1 and M_2 rested upon the closed eyelids, and were rotated by the rotation of the apices of the corneae beneath. If it was desired to record the movements of one eye only while the subject read with the other, one of the mirrors could be removed. Without careful calibration, however, it would be difficult to determine the exact relationship between the eye movements and the movements of the beam of light recorded by the camera.

In order to record head movements a small mirror M_3 was attached to the nose-piece N, and adjusted so that the reflected beam from it also fell on the recording apparatus. But in 1923 Dodge[19] invented a method by means of which the effects of head movements were almost entirely eliminated. (Dodge gives no diagram of his apparatus; for the sake of clearness I have, however, attempted to construct one (Fig. 9) from his description*).

* His description is far from lucid; I hope I have understood and reproduced it correctly.

A Dodge-Cline falling plate camera C was fastened to a rigid support above the subject's head so that the vertical axis of rotation of the head passed through the centre of the horizontal slit F. A projection P, also coinciding with this axis, worked in a socket K attached to the top of the subject's head by means of a broad elastic band. By this means the head movements were confined to rotations about the vertical axis. The source of illumination, A, a 100-watt. nitrogen-filled incandescent lamp with horseshoe filament, was situated just above and in front of the camera slit. A light framework was supported by two rods R_1 and R_2, one of which was gripped between the subject's teeth, and the other secured to a point just above the camera slit, so that it could

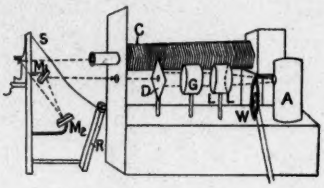

FIG. 10.

rotate in a horizontal plane about the vertical axis of rotation of the head. This framework carried two plane mirrors M_4 and M_5; the beam from the arc lamp was directed to M_4, reflected to the mirrors M_1 and M_2, back to M_4 and M_5, and thence to the camera slit, as shown in Fig. 9. Now, since the mirrors M_4 and M_5 could rotate with the rotation of the head, the beam of light would also rotate with the head, and the eye movements be recorded relatively to the movements of the head, *i.e.*, the effects of these movements upon the record would to all intents and purposes be eliminated. It was found that a record taken by reflection from the head mirror M_3 was virtually a straight line; showing that the desired results had been attained.

(11) A further modification of C. T. Gray's method was made by Miles and Shen[25] in 1925, in their work on recording the eye movements in the reading of Chinese. Light was supplied by a carbon arc lamp A (see Fig. 10) in front of which rotated a toothed wheel W at the rate of one revolution in five seconds; thus illumination took place in a series of discrete flashes of known duration, through the gaps between the teeth of the wheel. (One gap was stopped up; thus every five seconds there was a longer period of darkness, which made measurement from the record more easy). The beam of light then passed through a double lens LL, to render the rays parallel; its intensity

was suitably reduced by a blue glass screen and cooling cell G, and marginal light was cut off by a diaphragm D. The beam was then reflected obliquely on to the centre of the subject's cornea by two small mirrors M_1 and M_2, and thence to the recording camera C. The mirrors were slightly to one side of the subject, and therefore did not interfere with his view of the reading matter R in front of him. The latter was illuminated by means of an ordinary reading lamp to the left of and behind the subject. The print was covered by a piece of paper upon which were fixation marks corresponding to the beginning and end of the lines; this cover was secured by a rubber band which, when pulled towards himself by the subject with the string S, allowed the cover to fall and expose the print.

A long-barrelled camera projecting towards the subject was used for recording. A paper roll upon which were pasted strips of film 60 inches long and $2\frac{1}{2}$ inches wide was drawn vertically across the slit of the camera by a revolving drum which had special adjustments for starting and stopping it rapidly and altering its speed. The film could be moved horizontally for vertical eye movements.

The subject read with binocular vision; but only movements of the right eye were recorded. The head was fixated by means of an adjustable head and tooth rest; and head movements were recorded by reflection from a metal bead fastened to a spectacle-frame worn by the subject.

(*b*) Methods requiring the attachment of a capsule or recording lever to the eyes

(1) Lamare,[22] following up the work of Javal, attempted to measure eye movements by causing the movement of the lid to break the circuit of an electric current and give rise to sounds through a microphone, which he counted. He was unable, however, to obtain accurate results in this way.

(2) Ahrens[1] in 1891 attempted to record eye movements by attaching to the cornea a light ivory cup, to the apex of which was fastened a bristle that traced on a smoked drum. This method was not very successful either.

(3) In 1898, however, Delabarre[7] adapted this method. He made a plaster cast of an artificial eye, and trimmed it to the shape of the subject's cornea. The eyelids were propped open with a special framework, the cornea anaesthetized with cocaine, and the plaster cast fitted over it. A hole had been drilled in the centre of the cast through which the subject could see. A piece of wire was embedded in the plaster with one end projecting; this was connected by a thread to a lever tracing on a smoked drum. Delabarre also

used a cast with a small mirror embedded in it, reflecting light to a recording camera.

He did not experiment himself with this method. But in the same year E. B. Huey[17] made use of virtually the same method. The plaster cast was connected by a light tubular lever of celloidin and glass to a light thin aluminium pointer tracing on a smoked drum. A "spark" time recorder was used; an electric current from an induction coil, interrupted at regular intervals by a tuning-fork, passed through the pointer, and at each interruption the spark caused a spot of soot to fly off the drum. Huey claimed that no harm was done to the eye by this method provided that due precautions were observed; and that an accurate record of eye movements was obtained by it. He acknowledged, however, that the eye felt strained for some time after the plaster cast had been removed.

(4) In 1899 a further modification was invented by J. Orchansky[28]. He used a capsule made of glass or light metal. Above and below the central aperture for the pupil were flaps on which the eyelids could rest; and to one side was a slot in which could be inserted a fine rod tracing on a rotating drum, or another short rod bearing a vertical mirror parallel to the sagittal plane. Orchansky does not appear to have done much experimental work using this method.

(5) The method remained in abeyance till 1911, when Marx and Trendelenburg[24] employed it, using a very light aluminium capsule, of the same curvature as the cornea, adjusting it to the right size by pressing it on a suitable brass hemisphere. At the edge of the capsule was a lateral flap which fitted to the sclera when the capsule was applied to the cocainized cornea. The capsule had a central opening for the pupil, and a small mirror fixed just to one side of it. For horizontal eye movements the image of a vertical slit illuminated by an arc lamp was focussed on the mirror by means of a convex lens, and reflected from thence through a horizontal slit on a clockwork kymograph covered with bromide paper. The fixation mark was a small black point on a piece of paper fastened to an adjustable framework. The subject could move this framework until his eye, when fixating the mark, also reflected the image of the illuminated slit on to the slit of the camera. For recording vertical movements a horizontal illuminated slit and a vertical camera slit were used.

Head movements were recorded by the reflection of the illuminated slit by a mirror fixed with a spring clip to the bridge of the nose. The head was fixated as far as possible by means of a head rest with forehead band, side clamps and tooth rest.

This method gave a delicate and accurate method of recording the minute tremors of the eye during voluntary fixations. An

angle of eye movement of 1′ gave a displacement of approximately 1 mm. on the record. The observers did not allow a fixation to last for more than half-a-minute; it is not certain if the capsule would have remained in place for any length of time, or if it would have been displaced by the flow of tears. Thus it is doubtful if this method could be used for recording eye movements in reading.

FIG. 11.

(6) A simple piece of apparatus was described by A. Schackwitz[30] in 1913, which was used to measure the number and duration of eye movements in reading, but would be of doubtful accuracy in recording their extent. It consisted essentially of a small distended rubber capsule R (see Fig. 11) mounted on an adjustable spectacle frame in such a manner that it rested on the upper eyelid. It was connected by means of a thin brass tube T_1, and a rubber tube T_2, either to a Marey tambour or to a Marbe

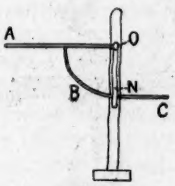

FIG. 12.

flame. The latter is an acetylene gas flame, also connected to a gas reservoir; when the capsule is compressed, the gas is driven out faster, and the increased flame forms a smoke ring on a strip of paper drawn through it by means of a rotating kymograph.

It is, of course, inevitable by this method that lid movements and eye movements should sometimes be confused. It is just possible that the capsule might be made to lie on the cornea without damaging it or obstructing the eye movements, so that this inaccuracy would be removed.

(7) For registering eye movements and lid movements J. Ohm[36] in 1916 made use of quite a different piece of apparatus, which is shown in Fig. 12. A light lever A B C swivelled about a point O;

one end C could pass freely through a slot N. This end was either fixed to the eyelid by means of court plaster; or a little stick of glass with a round head was fastened to it, and rested against the side of the cocainized cornea. The movements, greatly magnified, were recorded by the pointer on a kymograph. It is doubtful if this method would provide a very accurate or delicate method of recording eye movements in reading.

(8) J. L. Struycken[33] in 1918 is reported[34] to have photographed a minute sphere mounted on three legs attached by hooks to the cornea. A total reflection prism in front of the lens separated the beam of light and permitted the simultaneous recording of the vertical and horizontal components of the eye movement.

(c) Methods of direct observation

(1) Direct observation of the torsional movements of the eyes was made by B. Barnes[3] in 1905 and by M. Loring[23] in 1915, by very similar methods. The subject was asked to fixate the eye-piece of a telescope mounted facing him on a horizontal perimeter;

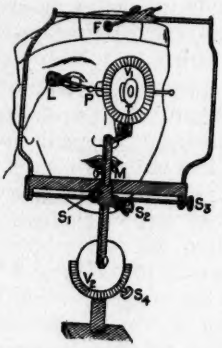

FIG. 13.

the cross wires of the telescope were then focussed on one of the striae of the iris. The telescope was then rotated to another position, the subject's eyes following the objective. The cross wires were again set on the same stria, and the angle of rotation of the eye-piece of the telescope gave the angle of torsion of the eye.

(2) A more delicate modification of this method was designed by Dr. Barany and described in 1911[2]; his apparatus is shown in Fig. 13. The eye was illuminated by a lamp L while fixating a point P, and observed by means of a telescope T the cross wires

of which could be rotated, and the angle measured on the vernier scale V_1. The subject's head was fixed to the telescope-stand by means of a mouth-piece M, and a screw fitting into a forehead band at F. The stand could be adjusted in three planes by the screws S_1, S_2, and S_3, and could be rotated about a horizontal axis parallel to the subject's line of regard by a screw S_4, the angle of rotation being measured on the vernier scale V_2. Also, by rotating the mouth-piece M, the subject's head could be rotated about its vertical axis. One of the striae of the iris was fixated on the cross wires of the telescope; the head was rotated in the desired direction, and the cross wires again fixated by rotating the vernier scale V_1.

(3) H. Ohrwäll[27] in 1912 and C. G. Sündberg[35] in 1917 observed both intra- and inter-fixation movements by means of a Blix's ophthalmometer. The image of the illuminated diaphragm of one of the microscopes of the ophthalmometer was reflected from the cornea to the other microscope, the eye-piece of which was fitted with a micrometer scale. The position of one of the striae of the iris, or of one of the blood-vessels of the conjunctiva, was noted on the micrometer scale; movements of this point were then measured directly on the scale. The voluntary movements of the eye from one fixation point to another could thus be observed and measured.

(4) In 1923, George, Toren and Lowell[15] measured the movements of the vertex of the cornea by the method of direct observation. The eye was fixated upon a needle fixed in the illuminated diaphragm at the further end of a tube. This tube could be swivelled around a horizontal arc, and could be adjusted in the vertical and in both horizontal planes; it was always placed so that it pointed towards the vertex of the cornea. The cornea was observed through a microscope adjusted to be at right angles to the tube when the latter was in its central position. The micrometer scale of the microscope was focussed upon the vertex of the cornea; and movements of the latter could be measured on the scale as the eye followed the rotating tube from one position to another. This method was used chiefly to demonstrate the horizontal movements of the cornea parallel to the sagittal plane.

Discussion of methods

Several points emerge from the foregoing description of methods of recording eye movements.

In the first place, with regard to photographic methods, nearly all investigators have used artificial light as their source of illumination. Dodge began by using daylight; but found an arc

lamp more convenient, because it was possible to obtain intermittent illumination with it. Judd, McAllister, and Steele made use of daylight, and employed an intermittent recording apparatus. It was pointed out, however, that measurement of the number, distance, and duration of eye movements from these records was very laborious. Those observers whose methods were devised primarily for the reading process, *i.e.*, Dearborn, Dodge, C. T. Gray, and Miles and Shen, have all used discontinuous artificial illumination; and it is because it is difficult to regulate and to render discontinuous that daylight is not very satisfactory for this purpose. The series of white dots forming a continuous line on a dark background is probably the most convenient and easily interpreted form of record to obtain. The duration of the movements or pauses is calculated by counting the dots. It has been found advisable to calibrate the direction of the movements by including in the record a few voluntary movements, the direction of which is controlled by providing suitable beginning and end fixation points. It may be pointed out that the use of an artificial source of illumination has not necessitated that the experiment should take place in a completely darkened room; Dearborn and C. T. Gray found that they were able to carry on their experiments in the daylight. If, however, daylight was not desired, the reading matter was illuminated by means of a suitably placed lamp, as in the method of Miles and Shen.

It should be noted that a great improvement was effected by Dodge in eliminating the effects of head movements, which apparently it is impossible entirely to prevent. It might be possible to substitute for the Dodge-Cline falling plate camera a moving film camera which would record more conveniently and accurately.

The advantages of the methods in which some capsule or recording lever is attached to the eye over those of photography of the "bright spot" are that they require less elaborate and expensive apparatus. A device such as that of Schackwitz or Ohm can be cheaply and easily fitted up. Their disadvantages are:

(1) They may cause some permanent injury to the eye.

(2) The anaesthetization of the eye, especially if cocaine* is used, and the weight of the capsule or lever resting on the eye may interfere with the natural movements of the eye, rendering them slower and of longer duration.

(3) On the mechanical side, these methods, with the possible exception of that of Marx and Trendelenburg, are of doubtful accuracy.

*Holocaine is said to interfere less with the normal movements of the eye.

It is very improbable that anything more than the approximate number and the general character of the fixation pauses and eye movements in reading can be observed directly, even through a telescope. The pauses last on the average only about 0.2 seconds and the movements 0.04 seconds each. Possibly very unusually long pauses and regressive movements might be noted in this way, even if they could not be measured.

In conclusion, then, it appears that the photographic method, as used by Dodge, C. T. Gray, and Miles and Shen, has proved the most completely satisfactory, though it is probably difficult to manipulate, and requires expensive apparatus. The rubber capsule used by Schackwitz, or the method of direct observation through a telescope, has been of use for preliminary or less detailed work.

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THE MOVEMENTS OF THE EYES IN READING

BY

M. D. VERNON, M.A.

CAMBRIDGE

IT was thought at one time that in reading the eyes move backwards and forwards smoothly and continuously, and perception of the words takes place during the movement. One is not conscious during reading of anything but a smooth and regular motion of the eyes. But in 1878, and the following years, Javal[16] and others working with him observed the movements of a subject's eye while he was reading, and found that this was not the case. Movement takes place in a series of jerks, with a pause after each movement during which the eyes are relatively at rest. Only during the backward sweep of the eyes from the end of one line to the beginning of the next is movement smooth and regular. It was observed that the short jerky, or saccadic, forward movements are very rapid; and that the durations of the pauses during which the eyes are fixated upon the print are much greater. The number and duration of the pauses vary considerably for different subjects and different types of reading matter.

Erdmann and Dodge[7] in 1898 and Huey[14] in 1900 made a number of observations on eye movements and fixation pauses, and a more extensive research was made by Dearborn[4] and published in 1906. At a later period C. T. Gray,[9] W. A. Schmidt[33], and G. T. Buswell[2, 3] made similar determinations. The results of these and of other observers are summarized in Tables I and III.

TABLE I.

NUMBER AND DURATION OF FIXATION PAUSES IN READING.

NAME OF OBSERVER AND CLASS OF SUBJECT.	Length of Line of Print in cms.	No. of Fixation Pauses per Line.		No. of Words read per Fixation.	Duration of Fixation Pauses in secs.	
		Range.	Mean.		Range.	Mean.
Javal (16) ... ...Adults	9.0	—	5	(10 letters)	—	—
Landolt (19) ... ... ,,	—	—	—	1.55	—	—
Erdmann and Dodge (7)... ... ... ,,	8.3	3 to 5	—	—	—	—
,, ... ,,	12.2	5 to 7	—	—	—	—
Huey (15) ... ... ,,	2.1	—	—	3.0		
,, ... ,,	5.0 to 6.0	3 to 4	3.6	3.6	—	0.185
,, ... ,,	9.8	2 to 7	4.5	1.9		
Dearborn (4) ... ... ,,	5.7	3 to 7	4.8	1.9 to 1.0	0.16 to 0.40	—
,, ... ,,	9.6	5 to 8.5	—	1.5 to 1.1	0.20 to 0.30	—
,, ... ,,	10.7	5 to 7.5	—	—	0.17 to 0.25	—
C. T. Gray (9) ... ... {Adults	(7 to 10 words)	—	6.9	—	0.174 to 0.364	0.226
{Children		—	10.0	—		0.284
Schmidt (23) ... ... {Adults ...	9.0	4.7 to 10.8	6.5	0.93 to 2.15	0.214 to 0.470	0.308
{Children over 14	9.0	5.0 to 9.6	7.0	1.04 to 2.04	0.244 to 0.414	0.311
{Children under 14	9.0	4.1 to 9.3	6.3	1.04 to 2.44	0.264 to 0.438	0.314
Buswell (3) ... ... {Adults ...	8.8	—	5.9	—	—	0.252
{Children over 10	8.8	—	6.9	—	—	0.248
{Children under 10	8.8	—	12.7	—	—	0.416
Judd and Buswell (18) ... Children about 16	9.7	—	6.9	1.19	—	0.250
,, ... ,,	10.0	6.1 to 8.5	7.2	—	0.176 to 0.236	0.221
Terry (26) ... ...Adults	9.3	—	6.1	1.7	—	0.215
Miles and Shen (20) ... ... ,,	—	—	—	1.9 to 1.8	—	0.300

TABLE II.

READING OF DIFFERENT TYPES OF MATERIAL BY FOUR CHILDREN AGED ABOUT 16.

Type of material read.	Av. No. of Fixations.		Av. Duration of Fixations in secs.		Av. No. of regressive Movements.	
	Range of 4 subjects.	Mean.	Range of 4 subjects.	Mean.	Range of 4 subjects.	Mean.
Fiction	6.1— 8.5	7.2	0.176—0.236	0.221	0.2—3.0	1.4
Geography	7.3—11.2	8.7	0.208—0.252	0.237	0.7—3.2	1.6
Rhetoric	7.7—11.7	9.1	0.200—0.300	0.228	0.6—3.7	1.8
Easy Verse*	8.4—13.1	10.2	0.200—0.272	0.246	0.3—3.7	1.8
Blank Verse*	8.5—16.8	11.7	0.208—0.272	0.248	0.5—6.1	2.7
French Grammar	8.0—14.1	11.1	0.204—0.300	0.264	0.4—4.0	2.3
Algebra	8.1—14.4	11.1	0.212—0.264	0.246	0.6—4.5	2.3

*The length of the lines of the verse was less than that of the other material; but the values given have been corrected accordingly.

TABLE III.

RANGE AND DURATION OF INTER-FIXATION EYE MOVEMENTS IN READING.

Name of Observer.	Short forward movements.		Long return movements.	
	Angle of movement.	Duration in secs.	Angle of movement	Duration in secs.
Dodge (5)	2° to 7°	Mean 0.023	12° to 14°	Mean 0.041
Huey (15)	3° to 4°	0.040 to 0.048	12° to 13°	0.051 to 0.058
Dearborn (4)	4° (approx.)	Mean 0.035	10° (approx.)	Mean 0.039
Schmidt (23)	—	0.010 to 0.030	—	0.030 to 0.050

Fixation pauses

It will be seen that the number and duration of the fixation pauses are variable; and the variation has been found to depend upon a number of different factors, objective and subjective. Chief among the former is the nature of the material read. In Table II are given the average number and duration of the fixation pauses in reading different types of material by four children, aged about sixteen years, as determined by Judd and Buswell[18]. It will be seen that the variation is very considerable. Familiarity with a given text also tends to decrease the number and duration of the pauses (see Table II).

The number of pauses is considerably affected by the length of the line of print. As far as can be judged from the figures given in Table I, the number of words read per fixation is greatest for a line of 5 to 6 cms. in length; on these grounds Huey[15] considered this to be the optimum length of line. The distance of the print from the eye seems to have little or no effect upon the number of fixations, and a reduction in the size of the print only slightly increases it.

Some observers have considered that the duration of the pauses is inversely proportional to their number. That this is only occasionally the case has been shown by Buswell[3]. He found that with children there was a correlation of $+0.49 \pm 0.056$ between length and duration of pauses; that is to say, few and short pauses went together. But for adults the correlation was -0.08 ± 0.055, showing that the length and duration were independent.

Dearborn[4] and, later, Schmidt[23] made a careful research into the location of the fixation pauses in the line of print. Huey[14] had shown that only 78 to 82 per cent. of the line of print is usually traversed by the eye; and that in general the indentation is greater to the right than to the left. Dearborn substantiated these findings. The indentation is greater for rapid than for slow readers; and it varies with the character of the end words of the line. The exact point of fixation is not of great importance; it may lie on any part of a word or on the space between two words. It is merely the point about which are grouped the letters and words which form the unit of perception, that is to say, the amount perceived during a single fixation. Schmidt concluded that there is a tendency to fixate the apperceptive unit centrally; but that this by no means invariably takes place. The number of words covered by a fixation varies greatly; it is large in the case of nouns, adjectives and verbs, and smaller for conjunctions and prepositional phrases, relative pronouns and auxiliary verbs. Familiarly associated words and well-known phrases are read at single fixation. This fact is in

agreement with the observations showing that the number and duration of the fixation pauses are much less for more familiar material; and that words the context of which is known are read more rapidly than when they are exposed singly and without context.

Dearborn considered that the duration of the pauses often varies regularly according to their position in the line of print. Readers have a tendency to form "short-lived motor habits" in regard to the duration of the fixations, after reading a particular piece of material for a short time. The first pause in each line is then, in general, the longest, followed by two or more very short ones, and a longer one towards the end of the line. This appears to indicate that the first pause involves a general survey of the line, or at least of its first part. These habits are, however, dependent upon the regularity of the print; they are not formed if the lines are of unequal length, or the margins irregular. Moreover, their formation is dependent upon the maturity of the reader and the ease and familiarity of the material read.

Both F. M. Hamilton[12] and R. Dodge[5] have drawn attention to the importance of marginal perception in reading. The right-hand marginal impressions serve as preliminary partial perceptions, and are essential for stimulation of the reflex eye movements (described below). They may vary from almost complete recognition to mere consciousness of "something there." There is an inverse correlation between the area of distinct vision and that of the marginal impression; but what is lost from a diminution of the breadth of clear preception is made up for by the preparatory and orientating effects of the marginal impressions. These effects may possibly be carried over a number of fixation pauses. Thus the marginal impressions gained in the first long fixation pause of the line may serve as stimuli not only for the immediately succeeding eye movements, but also for those following the next one or more fixation pauses, thus accounting for the extreme brevity of the latter. Dor[6] (*v. Brit. Jl. of Ophthal.*, Vol. VII, p. 196, 1923) cites the case of a woman with hemiopic scotoma of the right eye, which impaired almost the whole of the visual field, and with amblyopia of the left eye. She was quite unable to read with either eye singly. But when both eyes were used the very vague perception in the peripheral field of the right eye was sufficient to give a marginal impression which enabled the left eye to read. C. T. Gray[10] has also pointed out that it is extremely important that children beginning to read should learn to make use of their marginal impressions correctly, in order that the "leads" obtained from them may give rise to a correct final interpretation.

Inter-fixation and intra-fixation eye movements

It was found that the time occupied by the inter-fixation movements is very short compared with that occupied by the fixation pauses, *i.e.*, not much more than one-tenth as great; and that large-angled movements take not much longer to execute than small-angled movements (see Table III). The duration appears to be relatively constant for each individual. Probably the movements are not under voluntary control; they are dependent simply upon the speed of muscular reaction. This speed is approximately the same for eye muscles as for those of the hand, etc.; if it is slightly greater, this is due to the readiness of the muscles for stimulation, which in turn is set up by peripheral retinal stimulation. It was concluded that no perception takes place during movement; for the rate of movement is sufficiently great to cause fusion of stimuli, that is to say, a blurring of the print, should perception occur. Holt[13] was able to demonstrate central anaesthesia during eye movements. Assimilation of the reading matter takes place during the movements and also during the latter part of each fixation pause (see Table III).

The backwards and forwards movements have been shown to be confined more or less to the horizontal plane; that is to say, the eyes rarely stray above or below the line of print. This direction of movement has apparently become habitual to the eyes. Thus Stratton[25] showed that if the eyes are made to follow out the lines of a simple diagram, they move much more directly in the horizontal plane than in any other, with fewer corrective glides and angular changes of direction.

Very slight movements of the eyes also occur during fixation. The eye is never completely at rest, but fluctuates about a central position, moving through an angle of the order of 1′. This may be due to the fact that a number of nearly related points on the retina will give objectively the same stimulation to the brain (Dodge[5]). In addition, movements of convergence and divergence take place during reading. Divergence occurs during the inter-fixation movements, the eyes moving gradually downwards and outwards. During the fixation pauses convergent adjustment takes place (W. A. Smith[24]). The two eyes are not exactly co-ordinated either in the saccadic movements or the convergent and divergent movements. Schmidt found that with immature readers, whose convergent and divergent movements had not been perfected, a rapid movement of both eyes took place at the beginning of each fixation pause in a direction opposite to the normal direction of movement.

There is no doubt that the eye muscles are subject to fatigue as the result of prolonged reading. Landolt[19] found that small

angle eye movements are particularly fatiguing. Hence children tend to bring their books close to their eyes in order to increase the angle of movement; but the work of the accommodative muscles is thereby increased, resulting in a tendency to myopia. Dearborn found that unusually large-angled movements were also fatiguing; or rather, the fatigue incident on prolonged reading was particularly manifest in such movements, for in the course of a number of such movements the angle velocity decreased rapidly. The conclusion is that lines of print of moderate length, not more than 8.5 cms., are the least fatiguing to the eyes; the forward movements are not too short, nor the return movements too long.

Regressions and re-fixations

The earlier observers noted that in reading the eyes did not always move straight forwards along the line of print, but that frequently movements of regression occurred, and words were re-fixated. Dearborn found that these regressions were unusually numerous when the subject was beginning to read a passage, before he had time to establish any "short-lived motor habits." They also occurred when the print was irregularly arranged; and they were less noticeable with rapid than with slow readers. Moreover he noticed that with certain readers all such movements were merged in a semi-nystagmoid drift, during which the eyes moved at a rate much slower than normal, and perception took place. This phenomenon he considered to be related to the nature of the processes of assimilation of the meaning.

Schmidt observed that with children regressions are very frequent; he considered that the chief difference between mature and immature reading lies in the larger number of re-fixations shown in the latter. Buswell[3] found that the average number of regressions in the reading of a line of print 8.8 cms. in length was 3.1 for children under 9 years of age; 1.2 for children over 9; and 0.5 for adults; that is to say, the decrease is continuous, and the number does not reach its minimum until the age of 18 years or over. C. T. Gray[9] found that the length of the regressive movements also decreased with experience in reading. Later, Judd and Buswell[18] demonstrated that the most regular type of reading is shown by the mature reader when he is attending to the context rather than to the analysis of the material into its elements, as in the study of style, vocabulary, grammar, etc. In the process of analysis the reader returns to his immature habits. There are long pauses and many regressive movements; and in extreme cases, as was shown in the reading of Latin[18], the eyes may wander aimlessly backwards and forwards over the print, while the reader tries to assimilate the meanings of the

individual words. This strikingly different method of procedure is probably similar to the one noticed by Dearborn. C. T. Gray[10] considered that a regular "rhythm" was far more important for rapid and accurate reading than the actual number and duration of the fixation pauses.

Buswell[2] also noted another type of regressive movement among mature readers; when too long a forward movement has been attempted, and the eye has overshot the mark, it is obliged to re-fixate the words which have been missed.

Individual differences in eye movements and reading

It was noted above that the number and duration of the fixation pauses, and hence also the rate of reading (since they are highly correlated), are dependent upon many subjective factors. As would be expected, age has a large influence; this can be seen from the figures given in Table I. The decrease in the average number and duration of the pauses is very rapid up to the age of nine or ten years; after that it is much slower, and the average duration becomes practically constant about the age of eleven. The most efficient readers have been found to have very few, though sometimes rather long, pauses. The effect of age on the number of regressions was described above.

The differences between the eye movements and fixations of different individuals are very remarkable. Some adults appear more or less to retain their immature reading habits. Thus Schmidt found that in reading a 9 cm. line of print, the perception time, which is the product of the average number and duration of the fixations per line, varied from 1.14 to 3.68 seconds for adults; that is to say, it was three times as long for some individuals as for others. The perception time is dependent, apart from the regressive movements, chiefly upon the perceptual span, or span of recognition as it is called by some writers to distinguish it from the perceptual span for short exposure experiments; it is measured by the number of words read per fixation. It is in all probability a function of central rather than of peripheral processes. Ruediger[22] showed that there is no correlation between the number of pauses and rate of reading on the one hand, and the extent of the visual field, visual acuity, and retinal sensitivity on the other. Judd, McAllister, and Steele had previously come to the same conclusion[17]; and C. T. Gray[9] found that though reading rate and perceptual span are highly correlated, neither correlates with visual span. The perceptual span is thus in all probability dependent upon the rate of central assimilation of the meaning of the material read. Ruediger also considered that Dearborn's motor habits were probably a function of the ease and rapidity of reading, *i.e.*, of

central assimilation, rather than *vice versa*. This is borne out by the results of Judd and Buswell[18], who found that the individual differences in reading the various types of material listed in Table II were very considerable. That is, some individuals were able to assimilate more readily certain types of material, while some showed superiority with others, according to their individual interests in the subject matter.

It is probably true that some differences in ease and rapidity of reading are due to training. Those who are encouraged to concentrate upon rapid and efficient assimilation and comprehension of the meaning of the material, are, according to Freeman[8], likely to be better readers than those whose attention has chiefly been directed to the mere mechanics of reading. In general, efficient assimilation will engender rapid and regular fixations. On the other hand the work of C. T. Gray[9] and J. A. O'Brien[21] seems to show that children's rate of reading can be increased, without loss of comprehension, by speeding up the mechanical processes. They instituted speed drills in which the children were encouraged to read straight forwards without allowing their eyes to regress; and the perceptual span and rate of reading were increased to a greater extent than is normal among children learning to read.

W. S. Gray[11] has described a case in which disability in reading was very largely due to faulty eye movements. The subject, a boy of about ten years, was of good intelligence, and not in any way "word blind"; but his rate of reading was very poor, he was unable to recognize many simple words at sight, and could not understand their meaning when they were grouped in thought units. Photographic records of his eye movements showed:

(1) At least one fixation on every word in the line, and, whenever a word of any difficulty was encountered, a period of confusion involving several long fixations.

(2) Very irregular wandering forward movements, with many regressions while the subject tried to pick out familiar words.

(3) Irregular return sweeps, the eye moving gradually back over the line and not going straight back to the beginning.

The subject was given remedial training. He was required to read material in which the lines of print, and at first the words, but later the thought units, were widely separated from one another; this was in order to prevent confusion between the different lines, words and thought units. He was instructed to direct his eyes straight forwards and backwards along the lines. By means of these and similar methods his reading ability was greatly increased.

Anderson and Merton[1], also doing remedial work in reading, recommended that readers with very narrow recognition spans should be given "phrase drills," that is to say, short exposures of single phrases, to teach them to take in phrases at a single glance; and that new words should be presented as parts of sentences, in order to teach interpretation by means of the context.

The important part played by the movements of the eyes has thus been outlined by summarizing the results of the work of numerous observers on the subject. These moyements, though differing for different individuals, show a number of general similarities, particularly for the best readers, whose movements are regular and fixations few and short. It is probable that the nature of the movements is dependent to a considerable extent upon the central processes connected with the assimilation of the meaning and comprehension of the material read. But the movements can nevertheless be regulated both by direct training in the physiological processes, and also by means of the printing and general lay-out of the material read.

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MELANOSIS OF THE IRIS AND NEW FORMATION OF A HYALINE MEMBRANE ON ITS SURFACE

BY

D. J. WOOD

CAPE TOWN

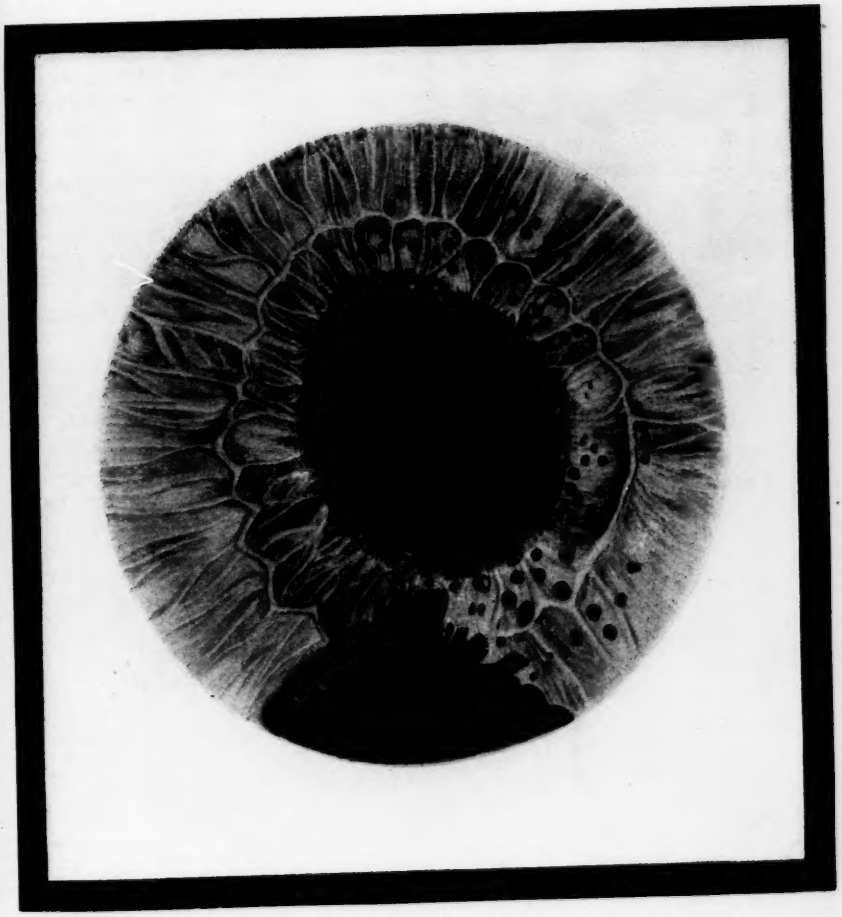
IN the end of July, 1925, I was consulted by a lady, Mrs. H. H., with a view to getting new glasses. She was sixty-three, had a little astigmatism, and with correction saw 6/6 with her right eye and 6/5 with the left.

The left eye, however, showed several peculiarities. The pupil was oval and eccentric upwards; the iris was in contact with the lens on the inner side only, and there was a large pigmented plaque on the iris below. The iris was dark greyish blue in colour.

Examination with the corneal microscope showed other abnormalities. On the outer side the iris was raised up in a ridge which apparently reached the cornea, there were a few dark specks on the cornea below, not like precipitates; there were some remains of pigment on the lens suggestive of persistent pupillary membrane, and there was coronary cataract. The most curious finding, however, was that all over the outer half of the iris, from its root to the edge of the pupil, there were large numbers of rounded eminences, brown in colour, and many of them raised sufficiently to cast definite shadows. The upper margin of the pupil showed a large uveal eversion, and even on this there were several nodules. There were none visible, however, on the pigmented plaque below. The endothelium, examined under a high power, showed no changes and the aqueous was absolutely clear. Nothing in the way of a growth could be seen on the outer side between the iris and the lens, though one could see as far as to the ciliary processes.

I spent some time in making a picture of the condition, though the patient was easily tired, and not enthusiastic. It illustrates fairly well the appearance when I saw her first. She disappeared until April, 1926, and returned then because of visual failure in the left eye. The cornea had become somewhat steamy, tension was higher than in the right eye, and fine details of the iris were obscured. Vision was only 6/9. One could see that there was no cupping of the disc, and the field of vision was full, but there was no doubt of the presence of glaucoma. There was also no doubt that the prominences on the iris had advanced further round, both above and below.

Eserine brought down the tension, and the cornea cleared, but the patient again ceased attendance, perhaps because I had begun to think ill of the eye and told her so. In August she returned



Slit-lamp Drawing. ×15 diameters.

with not merely increased tension but also some pain. Vision had gone down to 6/12. The nodules had spread all round the iris, and there was a bulge forwards in it above, similar to that on the outer side. It seemed difficult not to believe that one was dealing with a malignant condition, and one which did not justify any glaucoma operation. After much delay and consultations with all my colleagues and her friends she agreed to part with the eye and it was removed in November, sixteen months after her first visit. Unfortunately the eyeball was placed for several hours in an empty bottle, instead of the one containing Bouin's solution, so that it became somewhat collapsed. No tumour was found in any part of the eye and the posterior half was normal. Sections were cut in celloidin, some were bleached, and most were stained with haematoxylin and eosin.

Many abnormalities were found. The iris was overlaid with a hyaline membrane and endothelium continuous with Descemet's membrane, and extending over the edge of the pupil, being very visible where it covered the ectropion. At the site where the iris was adherent to the cornea the hyaline was thickened (Fig. 8), and not only did it pass over the pupillary edge, but it extended as far back as the position of the adhesion, *viz.*, nearly half-way across the uveal surface.

The angle of the anterior chamber was closed by the fusion of the two membranes in many sections, and in most Schlemm's canal was well behind the apparent angle of the anterior chamber. In the latter there were frequently seen clusters of hexagonal endothelial cells, and balls of pigment which when bleached showed sometimes a nucleus, but sometimes became mere ghosts of cells (Figs. 6 and 7).

The prominences on the iris were much more numerous than the *intra vitam* appearances suggested. Some sections contained only two or three, but upon others one could see up to a dozen between the iris root and pupillary edge. Some were composed of only a few cells, but most were larger and some were as high as half the thickness of the iris. Some lay flat on the surface, but most were raised up like golf balls on a tee (Figs. 1 and 2), and in a few one could see that the cluster of cells came through a distinct stoma in the hyaline membrane.

The outer cells of the nodules were rounded, with bodies which stained with eosin and had a round nucleus. They resembled the cells seen in the angle of the anterior chamber to which reference has been made. Many of the nuclei showed division. The bodies of the nodules were composed of cells, whose cytoplasm was almost filled by a nucleus, and were concentric, elongated ovals, or irregular in shape. They were arranged concentrically in nearly all instances where the nodule was other than small. In all there

was pigment, sometimes so much as to make the prominence look black. The pigment was in two forms, either intracellular and composed of fine granules, like the pigment in the iris stroma, or forming rounded agglomerations, and amorphous in type (Fig. 4). The nodules were apparently firm in consistence, as it was rare to find one cut by the knife: they were pushed aside and retained their spherical shape. The cells forming the centres of the nodules were also found in large numbers all over the front surface of the iris. Scattered through the iris were other small oval cells with no bodies that one could discern, staining a brighter blue, and forming clusters in the sphincter area in front of the muscle, and in the inner part of the ciliary body. In some sections the ciliary cluster was very noticeable, and the cells could be seen streaming away from it in lines into the iris root, into the back of the ciliary body and forwards to the canal of Schlemm (Figs. 3, 5 and 6). Their arrangement suggested that the primary focus of the trouble might be in the ciliary body, and that one was dealing with a neoplastic condition arising there and secondarily spreading into the iris. This would at least be an understandable explanation.

After much examination I have, however, come to the conclusion that these cells are not small round sarcoma cells, but small lymphocytes, and the case as a whole must therefore be inflammatory in origin, though it becomes much more obscure in interpretation.

Up to the time when one could no longer get the cornea clear by the use of eserine to lower tension, it is certain that no inflammatory changes were present which could be detected by careful slit-lamp examination, yet evidences are brought out by the microscope that slight inflammation had been present. In the root of the iris were to be seen a few plasma-staining cells, and a smaller number whose bodies were full of eosinophile granules. In the part of the iris which was adherent to the cornea the vessels showed hyaline thickening of the coats. The iris contained numerous clump cells, and there were balls of pigment free in the angle of the anterior chamber. Besides these points there were the clusters of cells in the ciliary body, and sphincter area, and lastly the hyaline membrane.

It is a curious point that up to the end I was sure that the only adhesions of the iris to the cornea were on the outer side and above, and both some distance from the pupil, yet the sections show an adhesion of the edge of the pupil above, which is packed with lymphocytes and is covered by an extra thick hyaline coating.

It seems agreed that the formation of a hyaline membrane on the iris is a sequence in cases of chronic glaucoma. In this case, however, it must have been in existence before glaucoma occurred, as it forms part of the prominences which were well marked when

FIG. 1.

Bleached section. A darkly stained nodule. Deeply stained oval nuclei in front of sphincter muscle. Muscle and uvea are bent round this layer of cells. Zeiss C. X 5.

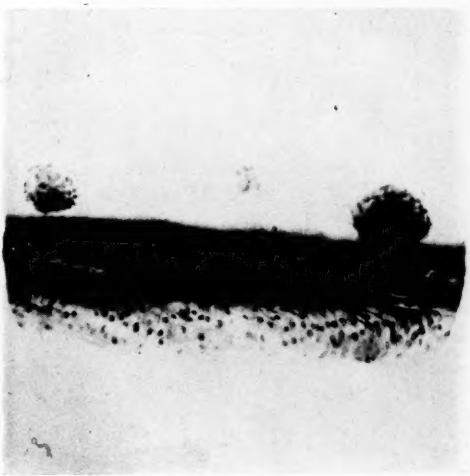


FIG. 2.

Bleached Section. Typical nodules. Zeiss C. X 5.

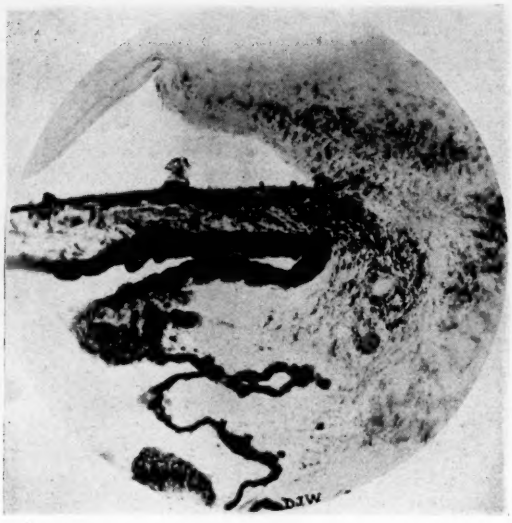


FIG. 3.

Angle of anterior chamber Zeiss A×5. A large nodule. Balls of pigment in angle. Pigmented stroma cells and small oval cells streaming from pigmented plaque into ciliary body. Unbleached.

FIG. 4.

Nodule in Fig. 3 Zeiss D.D.×5. The larger dark spheres are agglomerations of amorphous pigment. Unbleached.

FIG. 5.

Cell cluster in ciliary body. Cells passing in lines into the iris. Zeiss AA×10. Bleached.

FIG. 6.

Large cell cluster in ciliary body. Cells streaming into posterior part of ciliary body. Endothelium in angle of A.C. Bleached.

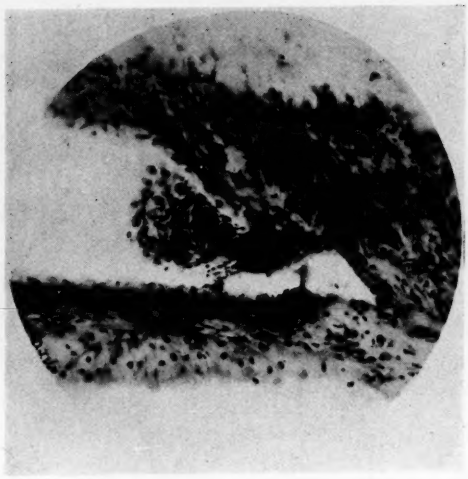


FIG. 7.

Nodule attached to the pectinate ligament and ? to iris. Superficial cells show rounded bodies staining with eosin. Deeper cells show no bodies. Stain well with haemalum.

FIG. 8

Section through iris adhesion. Hyaline membrane passing on to cornea, and also on posterior surface of iris. Thickening of walls of blood vessels.

the case was first seen. The nature of the cells forming the prominences is another problem. Some have bodies which stain readily with eosine and have a small round nucleus. Are these as it would seem endothelial? If so, what are the other cells which show practically no body but which are similar to the large numbers of cells seen on the iris surface and which ought to be endothelial?

I have sent some of the sections to Mr. Treacher Collins with a request to review the case and add his opinion.

Remarks by E. Treacher Collins

In complying with Dr. Wood's request, to write my opinion concerning the sections he has been good enough to send me of this very remarkable case, it will, I think, be well to consider separately the several different features which it presents, and then endeavour to ascertain their relation to one another.

Its several different features are:

(1) The presence of a layer of hyaline tissue, like that of Descemet's membrane, on the surface of the iris.
(2) The abnormal deep pigmentation of a sector of the iris.
(3) The rounded nodules on the surface of the iris.
(4) The localized groups of closely packed cells, at the pupillary border of the iris, and at its junction with the ciliary body.

(1) It is now generally agreed that the hyaline layer of Descemet's membrane is the product of the endothelial cells lining it (*Roy. Lond. Ophthal. Hosp. Reps.*, Vol. XIV, p. 305, 1896). In my Erasmus Wilson Lectures at the Royal College of Surgeons (*Lancet*, February, 1900) I pointed out that pathological formations of such hyaline membranes occurred: (*a*) after perforating wounds of the cornea, where the gap left by the retraction of the divided ends of Descemet's membrane becomes bridged across, first by endothelial cells, and later by a new formed hyaline layer; (*b*) in cases of anterior synechia of the iris, formed either by perforation of the cornea or as the result of a failure in separation of the iris from the cornea in foetal life, where a new formation of a hyaline membrane extends over the surface of the iris from the seat of the adhesion with endothelial cells on its anterior surface; (*c*) in cases of long standing glaucoma, where the angle of the anterior chamber has been blocked for some time by adhesion of the root of the iris to the back of the cornea, and where a new formed hyaline membrane is found to spread round the angle of the chamber on to the anterior surface of the iris, endothelial cells being present on its anterior surface.

In this article I suggested that the endothelium of the iris seemed to have acquired the function of forming a hyaline membrane like that of the endothelium of Descemet's membrane.

A reconsideration of these cases makes me think it more probable that there is, in the first place, an extension of the endothelium of Descemet's membrane on to the surface of the iris along the course of the anterior synechia, and that it is this endothelium which is responsible for the development of the hyaline membrane, and not that on the anterior surface of the iris. Wood's case shows definitely that an extension of endothelium must have preceded the formation of a hyaline membrane, for in it, there is not only a newly-formed hyaline membrane lined by endothelium on the anterior surface of the iris, but an extension of it round the pupillary border of the posterior surface, where no endothelium normally exists.

At the site of one of the adhesions of the iris to the cornea in Wood's case, which is situated in the position of the small circle of the iris, there is a considerable thickening of hyaline tissue, equal to five or six layers of superimposed Descemet's membrane. Hyaline tissue of this character is very slow in formation, and both this thickened mass, and the new layer on the surface of the iris, must have taken a considerable time to develop. There is no sign of there having been any perforation of the cornea at the seat of the adhesion or of any past inflammation. I think it is most probable that the adhesion is due to a congenital failure in separation of the iris from the cornea. In a case of my own which had a congenital anterior synechia of the iris near the pupillary border, and congenital buphthalmos, there was a thickened hyaline mass, similar to that in Wood's case, and a layer of hyaline tissue on the anterior surface of the iris.

(2) In a case recorded by Dr. A. B. Rees (*Amer. Jl. of Ophthal.*, Vol. VIII, p. 863, 1925) of melanosis of the eye he describes the iris as showing in section, microscopically, a ribbon of pigment anteriorly, so dense and thick that it resembles the pigment on the posterior surface of a normal iris. In Wood's case there is a similar dense pigmentation of the anterior layers of the iris over the melanotic sector. In specimens which I have examined of melanosis of the iris (*Trans. Ophthal. Soc. U.K.*, Vol. XLVI, p. 104) there was also dense pigmentation of its anterior layers, its endothelium and the cells of its anterior limiting layer. Rees also describes how he found in the stroma of the iris in his case, chromatophores which had "acquired so much pigment that they are globular in shape, and show no pigmented processes as seen in typical chromatophores." He compares these globular pigmented cells to "clump cells," and says that all gradations can be seen between them and the normal branching chromatophores. Near the root of the iris in the melanotic area in Wood's case, clump cells can be seen both in the stroma and in its anterior layers, and all gradations can be traced between them and darkly pig-

mented chromatophores. These gradations in the formation of "clump cells" support Ginsberg's view that they originate in chromatophores, rather than Elschnig's and Lauber's that they are derived from the pigment epithelium. On this matter I was able to quote some very strong evidence in the discussion on Intra-ocular Melanomata at the Ophthalmological Society in 1926.

There is nothing in the history of Wood's case to show how long the melanotic area had been present, but in view of what is known with regard to similar patches in other cases, I think in all probability it must have dated from birth or early infancy.

(3) Several cases of melanosis of the iris have been recorded in which prominences, of various sizes and shapes, have been seen clinically on the surface of the iris. In Wood's case the prominences are more globular than in those previously described. Histological examination in two of the previously described cases seemed to show that they were mainly composed of endothelial cells, but it is always very difficult to differentiate the cells of the anterior limiting layer of the iris from the endothelium. In Wood's case the round projections seem to be made up partly of endothelial cells and partly of a smaller variety of cells. Some of them are deeply pigmented and others less so. Those situated over the melanotic area—for histologically some are found there though they were not visible clinically—are very deeply pigmented, and in some instances contain clump cells. The nodules in the sections appear frequently as detached circular groups of cells lying superficial to the hyaline layer on the surface of the iris, others, however, have a definite pedicle which passes through the hyaline membrane, so that the cells of which they are composed are continuous with those of the tissue of the iris. As Wood aptly says some of them appear raised up like golf balls on a tee. The detached appearance of some of the nodules is probably due to the narrowness of their pedicle which is not cut across in some of the sections. The situation of these nodules on the anterior surface of the iris suggests that possibly they may be connected with some persistence of the irido-pupillary membrane, beneath which the iris grows in foetal life. Wood notes that he saw clinically some remains of pigment on the lens suggestive of persistent pupillary membrane. If these prominences on the surface of the iris are remnants of the irido-pupillary membrane, then the hyaline membrane which has formed on the surface of the iris has failed to spread over them, though it has formed around them. Possibly its formation may help to account for the unusual globular shape of the excrescences.

(4) Melanosis of the iris has several times been noted as occurring in association with pigmented naevi of the skin of the eyelids or of the face. In such pigmented naevi of the skin there

are frequently found, besides pigmented cells, unpigmented cells of an embryonic type. It is in such patches of embryonic tissue that malignant growths are liable to originate. In Wood's case there are closely packed groups of unpigmented cells of an embryonic type at the pupillary margin of the iris, where it is adherent to the cornea, and at its junction with the ciliary body. In some of the sections these cells appear to be mostly round in shape, but some spindle-shaped ones are seen to be intermingled with them. In other sections the group of cells at the pupillary margin appears to be mostly composed of spindle-shaped cells. Where round and spindle-shaped cells appear to be mixed together in a section it is always uncertain if the apparent round cells may not really be spindle cells cut transversely. These accumulations of cells in Wood's case do not appear to be inflammatory, and certainly the spindle-shaped cells are not of that nature. Whether or not they are areas commencing to take on malignant activity cannot be certainly determined by histological examination alone.

At the seat of the adhesion of the pupillary margin of the iris to the cornea there seems to be some abnormal distribution of the blood-vessels of the iris, and also, as Wood remarks a marked sclerosis of some of the vessel walls.

Such being the several different features of interest in this case, in what relation do they stand to one another? A general review of them seems to point to a primary congenital defect in connection with the irido-pupillary membrane; resulting in its imperfect separation from the back of the cornea, so producing the anterior synechiae; and persistence of portions of it forming protrusions on the surface of the iris. There must also have been a formation of a congenital naevus, resulting in the production of the abnormal area of pigmentation and areas of embryonic tissue. The endothelium of Descemet's membrane, due to the anterior synechiae, spread on to the surface of the iris and formed there an abnormal hyaline layer. This hyaline layer extending round the angle of the anterior chamber in a portion of its extent, as well as over the surface of the iris, must have caused some hindrance to the normal channels of exit for fluid from the eye, and so predisposed the eye to glaucoma. It is remarkable that symptoms of glaucoma did not appear earlier than they did. Possibly the areas of embryonic tissue were commencing to grow and manifest malignant tendency, and this may have accounted for the recent onset of glaucomatous symptoms, which led up to the excision of the eye.

ANNOTATIONS

Registration of Opticians

We publish on page 155 of this issue a notice of the Report of the Committee appointed last year to consider the Optical Practitioners' (Registration) Bill (*vide Brit. Jl. of Ophthal.*, Vol. XI, p. 235, 1927). Our readers will be in a position to draw their own conclusions, since we print the recommendations of the majority report in full. It is gratifying to ophthalmologists that the majority report is adverse to the Bill. Neither the majority nor either of the minority reports, however, can be regarded with complete satisfaction. The former, while admitting that there is a *prima facie* case for setting up a State register in order to produce some sort of order out of the present chaos, considers that a non-prohibitive register would be worse than useless, and that it would not be possible to set up a prohibitive register at the present time. The first of the two minority reports, that signed by three members, takes its stand on the unfortunate prevalence of ignorant and incompetent opticians; they consider that the only way in which to deal with the evil is either to prohibit entirely any unregulated practice, or to provide some means of identification whereby the public may be able to distinguish between regulated and unregulated practice. They conclude that the case for the regulation of the practice of optometry by means of a State register is well supported, and that the Committee incurs a serious responsibility in making an indeterminate report. The last of the three reports emphasizes the fact that the business and practice of optometry is in a state of chaos, and that the number of ophthalmic surgeons is inadequate. It may, however, be pointed out that the number of qualified medical men capable of dealing with errors of refraction has increased rapidly during the last few years, and especially since the institution of the D.O. and D.O.M.S. examinations.

The Bowman Library

We all know that the library of the Ophthalmological Society, which was presented to the Royal Society of Medicine, has been housed there for many years in an upper room which was seldom visited by any members of either Society. At the same time and in the same building there were the ophthalmological books and periodicals belonging to the Royal Society of Medicine. It was inevitable that in such circumstances there should be overlapping, a state of affairs which has appeared unsatisfactory to each successive librarian of the Bowman Library. About seven years

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ago an attempt was made to improve matters. A sub-committee of the Ophthalmological Society met Sir John MacAlister on several occasions, but beyond getting arrears of binding of the Bowman periodicals made good, not much was accomplished. Inquiries made at this time as to the cost of fitting the Bowman room with shelves proved that this would be very expensive, while the Society's bookcases were valued at a ridiculously low figure in the second-hand market.

Representatives of the Councils of the Ophthalmological Society and of the Section of Ophthalmology of the Royal Society of Medicine, last year, formed a Committee to discuss methods of improving this unsatisfactory state of affairs. As a result of their deliberations the following changes have been made:

The Bowman Library has been enlarged so as to include all the ophthalmological books and periodicals in the Royal Society of Medicine and it has been made more accessible by being located in the main library of the Royal Society of Medicine. The shelves containing these books have a notice over them bearing the words "Bowman Ophthalmological Library," and each volume contains a label to the same effect. When duplicates occur, the better copy is kept in the library, the other being housed in the basement, where owing to a new system of arrangement it is readily accessible. The shelves in the basement also accommodate rare or interesting volumes which formed part of the original collection, but are not in constant demand. Even the old bookcases are preserved, two of these having been presented to the Society by Sir William Bowman.

With regard to periodicals it was thought at first that the new arrangement would obviate duplication of them, but further consideration has shown that the possession of duplicate copies of the more important journals would be a distinct asset to the library. It has, therefore, been decided to continue the exchanges of both the "Transactions of the Ophthalmological Society" and the "Proceedings of the Royal Society of Medicine," in order to permit of this. All new books relating to ophthalmology which are bought by the Royal Society of Medicine will pass into the Bowman Library, the whole of which will be accessible to members of the Ophthalmological Society even if they are not Fellows of the Royal Society of Medicine.

The advantages of these changes are obvious and British ophthalmologists will have at their disposal a library which is really worthy of its founder, Sir William Bowman. We all owe a debt of gratitude to those who have worked together to accomplish this state of affairs; notably to Mr. Edwards, Mr. Powell and his subordinates on the main library staff; to Mr. R. R. James and Mr. Williamson-Noble, the past and present librarians of the

Bowman Library; and to Sir John Parsons, who as President of the Ophthalmological Society has made many valuable suggestions to the Committee. It should be easy to keep the library up to date, as all new works are purchased by the Royal Society of Medicine on the recommendation of the ophthalmological representative on the Library Committee. The hard work, ungrudgingly given, by previous librarians of the Bowman Library, notably by Mr. Adams Frost, will not be wasted, for in its new setting the ophthalmological library will be one of the finest in existence.

THE COUNCIL OF BRITISH OPHTHALMOLOGISTS

THE Council of British Ophthalmologists presents the following report on an Inquiry "**How far the recommendations of the Departmental Committee on the Causes and Prevention of Blindness with reference to Ophthalmia Neonatorum have been put into practice.**"

The recommendations of the departmental committee were as follows:

(1) We recommend that in every area, whether urban or rural, the Ministry of Health should take measures to secure the provision of suitable hospital accommodation for babies suffering from ophthalmia neonatorum and for their mothers.

(2) We recommend that the Ministry of Health should take steps to ensure that adequate nursing provision is always available for cases of ophthalmia neonatorum which are not admitted to hospital.

(3) We recommend that in cases of suspected ophthalmia neonatorum facilities for consultation with an ophthalmic surgeon and for bacteriological investigation should be provided wherever practicable.

(4) We recommend that arrangements should be made for pupil midwives to visit ophthalmic hospitals, or the ophthalmic departments of general hospitals for the purpose of gaining direct experience of ophthalmia neonatorum.

In order to determine how far practical measures are being adopted on these lines the following questionnaire was distributed to ophthalmic surgeons in all the important ophthalmic centres in Great Britain:

(1) (*a*) Have you adequate hospital accommodation in your district for the admission of both infants and mothers in the severe cases?

(*b*) Have you out-patient facilities for the treatment of the milder cases with ophthalmic supervision?

(2) Have you in your area skilled nurses who could be called on to give the adequate amount of attention to these cases?

(3) (*a*) Are ophthalmic surgeons being called into consultation in your district for this purpose?

(*b*) Are there facilities for bacteriological investigation available, and are they being utilized?

(4) (*a*) Are there such facilities in your district?

(*b*) Are the nurses attending and getting practical instruction? If not can you make any suggestions which would further these ends?

(5) (*a*) What is the number of cases of ophthalmia neonatorum which occurred during the last four years in the counties or boroughs in your district?

(*b*) What is the number of cases of defective vision and blindness resulting therefrom? (Such information can probably be obtained from the local Medical Officer of Health.)

(6) Do the medical students in your teaching schools (if any) gain practical experience of ophthalmia neonatorum and its treatment?

Eleven replies were received from the London area.

Fifty-one replies were received from the towns or county areas for the rest of England and Wales.

The replies from *eleven* counties in Scotland were summed together.

The data received are of course by no means complete for the whole country, but are considered to be fairly representative of the conditions which exist.

The answers to the various questions are summarized as follows:

(1) (*a*) Have you adequate hospital accommodation in your district for the admission of both infants and mothers in the severe cases?

REPLY: *London area.*—"Yes," or "sent to St. Margaret's:"

Rest of England. 43 Yes, but of these in two it is stated they take the babies but not the mothers.

In one large town the accommodation is said to be barely adequate.

7—No. 1—not answered.

Scotland—10—Yes. 1—No.

(1) (*b*) Have you out-patient facilities for the treatment of the milder cases with ophthalmic supervision?

REPLY: *London*— Yes.

Rest of England.—

42—Yes. 6—No. 1—not answered. 2—doubtful

Scotland—6—Yes. 5—No.

(2) Have you in your area skilled nurses who could be called on to give the adequate amount of attention in these cases?

REPLY: *London*—as a whole—Yes (but this probably means at hospital).

Rest of England.—39—Yes. 7—No.

One large town has trained visitor who distributes cases to doctors or hospitals.

One town—doubtful.

One town—partial.

Two towns—no reply.

Scotland—All—Yes.

Considering the small number of nurses in the country who have had skilled ophthalmic training, and also the difficulty of treating sporadic cases occurring in the outlying country districts the Council is inclined to think that the affirmative replies to this question must be somewhat optimistic, especially those from Scotland, which are unanimous in stating that adequate nursing provision is available.

The situation could be materially improved (see recommendations), not only by making the large towns which have ophthalmia neonatorum centres definitely responsible for larger surrounding areas, but by mapping out the whole of the country into districts which shall have each an ophthalmia neonatorum centre, and by issuing clear instructions to the Medical Officers of Health, that cases from these areas should be sent in by ambulance transport of both mother and child where necessary, at the earliest possible moment for treatment. (Compare organization for asylums.)

Such an administrative change would appear advisable from the experience at ophthalmia neonatorum centres where it is found that cases coming from the immediate neighbourhood are seen early and do well, while those which come from outlying areas are—owing to difficulty and delay in transport—seen late on in the disease, when irreparable damage has often already been done.

(3) (*a*) Are ophthalmic surgeons being called into consultation in your district for this purpose?

REPLY: *London*.—The answers are "not by local authority," or "no—except at the hospitals."

Rest of England.—38—Yes. 10—No.

In one town the V.D. Officer superintends treatment.

In two towns no answers were given.

Scotland—6—Yes. 5—No.

These replies appear quite as good as could be expected as a whole. In the districts where it is stated ophthalmic surgeons are not being called into consultation, there are hospitals or infirmaries in the immediate vicinity to which the babies could be brought.

(3) (*b*) Are there facilities for bacteriological investigation available, and are they being utilized?

London.—Bacteriological investigation always available—(at hospitals).

Rest of England.—44—Yes. 7—No.

Scotland.—10—Yes. 1—No.

Since the treatment is dependent on the clinical appearances rather than on the actual bacteriological finding in the large majority of the cases, we are of opinion that the facilities for bacteriological examination are adequate.

(4) The Departmental Committee recommended that arrangements should be made for pupil midwives to visit ophthalmic hospitals, or the ophthalmic departments of general hospitals for the purpose of getting direct experience of ophthalmia neonatorum.

QUESTION: (*a*) Are there such facilities in your districts?

REPLY: 24—Yes. 24—No. 3—not stated.

Of these 24 negative replies, most are from smaller towns where midwives would probably not be trained, but the list includes a number of large towns.

QUESTION: (*b*) Are the nurses attending and getting practical instruction? If not, can you make any suggestions which would further these ends?

Of the 24 centres in England (excepting London) where instruction is given in nine it is stated that the nurses are not getting practical instruction.

London— 5—Yes.

Scotland—4—Yes. 7—No.

The general lectures which are given to nurses at training centres include the care of babies' eyes in maternity cases, but owing to the lack of material, no regular practical instruction is possible, with certain exceptions.

In London such instruction is given at St. Margaret's and to some extent at the Royal London Ophthalmic Hospital. St. Margaret's is the chief centre in London both for lectures and practical instruction. The greater number of serious cases occurring in the London area being sent to this hospital, there is little clinical material at the other hospitals on which to base practical teaching. At St. Margaret's there is ample and full organization for instruction, but in our opinion it is still not used as it should be.

Throughout the country either the absence of sufficient numbers, or the faulty centring of cases of ophthalmia neonatorum for treatment at the ordinary hospital clinics is largely responsible for the regrettably small amount of practical instruction given on this subject to district nurses, midwives, and medical students.

The mapping out of the whole country into definite areas each with its ophthalmia neonatorum centre, as already recommended, would not only ensure much more efficient treatment of the cases themselves, but at the same time supply the material to make possible the organization of practical courses of instruction.

Such instruction, in the opinion of the Council, should be made a compulsory part of the training both of district nurses and of midwives.

With a view to getting some idea:

(1) As to the incidence of ophthalmia neonatorum throughout the country and the number of cases of blindness or impairment of sight.

(2) As to the practical instruction given to students in teaching schools.

The following questions also were asked:

(5) (*a*) What is the number of cases of ophthalmia neonatorum which occurred during the last four years in the counties or boroughs in your district?

(*b*) What is the number of cases of defective vision and blindness resulting therefrom? (Such information can probably be obtained from the local Medical Officer of Health.)

It is difficult to know how much stress can be laid on the actual figures given owing to the incompleteness of the returns. For example: in several, no numbers are given; in some, the cases of blindness and defective vision are classed together. In others the numbers for only one or two years are given, rendering comparison impossible.

Though the Council feels that the returned figures cannot be looked upon as strictly accurate it would like to call attention to the excellent returns and results in some of the large towns, especially—

Manchester:	—2,278 cases—	no blind, 3 defective.
Liverpool:	—2,727 cases—	4 blind, 18 impaired.
Birmingham:	—1,665 cases—	4 blind, 17 defective.
London:	—2,869 cases—	1 blind, both eyes.
(St. Margaret's)		4 blind, in one eye.
		30 both eyes impaired.
		56 one eye impaired.

On the other hand, some returns are disappointing. The Council is of opinion that the good returns from the larger centres, as compared with some of the smaller ones, form strong argument for the centralization of cases of ophthalmia neonatorum as already recommended.

(6) Do the medical students in your teaching schools (if any) gain practical experience of ophthalmia neonatorum and its treatment?

In 38 of the centres from which replies are obtained there are no teaching schools.

Five—Yes.

To meet the serious and widespread absence of practical experience and instruction of students in the treatment of ophthalmia neonatorum the Council is making a recommendation to the General Medical Council.

Summary of Recommendations

In view of the continued prevalence of ophthalmia neonatorum and its serious effect on sight, leading to misery and incapacity, as well as to public and private expenditure, the Council recommends that:

The MINISTRY OF HEALTH be advised:

(1) That the whole country be mapped out into districts, each of which should have an ophthalmia neonatorum centre; and that all large towns which have an ophthalmia neonatorum centre should undertake the treatment of cases occurring not only in the towns but in the surrounding areas.

(2) That where necessary, existing centres should be responsible for larger areas than at present, and that arrangements be made for ambulance transport of both mother and baby, if required.

(3) That it should be made a compulsory part of the training of district nurses to attend one of these centres for practical instruction in the application of treatment in such cases.

The CENTRAL MIDWIVES BOARD be advised:

That, in accordance with the recommendation of the Departmental Committee, as centres for the treatment of ophthalmia neonatorum are established, it should be made a compulsory part of the training of midwives to attend one of these centres for practical instruction in the recognition of these cases.

The GENERAL MEDICAL COUNCIL be advised:

That it should be made compulsory for all students to attend once at least at one of the ophthalmia neonatorum centres for practical instruction in the management and treatment of these cases, the most convenient time in the curriculum being during attendance at the course on fevers.

INTERNATIONAL OPHTHALMOLOGICAL CONGRESS, 1929

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Section on Ophthalmology, College of Physicians of Philadelphia.
Ophthalmological Society of Egypt.
Ophthalmological Society of Valparaiso.
Ophthalmological Society of Warsaw.

A group of German ophthalmologists, by favour of Geh. Hofrat Professor Dr. Th. Axenfeld.

INDIVIDUALS.

Ask, Fritz.
Chaillous, J.
Cirincione, Giuseppe.
Cirincione, Speciale.
Cozzoli, Giulio.
Dalén,Albin.
Fileti, Antonio.
Finnoff, Wm. C.
Gomès, Pereira.
Ishihara, Shinobu.
Lo Cascio, Girolamo.
Luppino, Andrea.
Maggiore, Luigi.
Margotta, Giuseppe.
Oguchi, Chuta.
Ovio, Giuseppe.
Picciche, Speciale.
Radcliffe, McCluney.
Roselli, Romeo.
Sartain, Paul J.
Snell, H. C.
Terrien, F.
Velez, Daniel M.
Wardale, J. D.
Zappalà, Antonino.

ABSTRACTS

I.—REPORT OF COMMITTEE ON OPTICIANS' (REGISTRATION) BILL

*Report of the Committee appointed by the Minister of Health and the Secretary of State for Scotland on the Optical Practitioners' (Registration) Bill, 1927.

The Committee appointed last year to consider the Optical Practitioners' (Registration) Bill (*Brit. Jl. of Ophthal.*, Vol. XI, p. 235, 1927) has issued its report consisting of a majority report, signed by nine members including the chairman, and two minority reports, signed by three members and one member respectively,

* Pp. 27. H.M. Stationery Office, London, 1927. Price 6d.

the latter, Mr. Rhys J. Davies, being abroad when the report was drafted.

The proceedings were conducted in private, no reports being made to the Press. An appendix gives the names of the bodies and persons who submitted statements of evidence to the Committee. This evidence was considered to be too voluminous to be printed, but, judging from the list, the side of the optician was adequately represented, as well as that of the approved societies.

The Committee state that they did not consider themselves restricted to a consideration of the registration of opticians under the provisions of the present Bill, but thought it advisable to examine in a comprehensive manner the problems which the subject appeared to them to raise. Thus, Part I of the report deals with the consideration which these problems have already received in this country; to the chief factors which have contributed in recent years to the necessity for an inquiry; to the provisions for registration in other countries; and to the nature and promotion of the Bill under consideration. Although a "Sight Testing Opticians' Bill" was introduced into the House of Lords as far back as 1906, the subject was first seriously discussed by the Departmental Committee on the Causes and Prevention of Blindness and the Royal Commission on National Insurance which reported in 1922 and 1926 respectively (*vide Brit. Jl. of Ophthal.*, Vols. VII and XI, pp. 57 and 93, 1923; and pp. 27, 235, 288, 1927). The report at present under notice recapitulates the nature of the evidence on which the Departmental Committee decided against the claim to registration and also the considerations which led the Royal Commission to point out that similar difficulties were being encountered to those met with when the State found it necessary to limit the practice of dentistry and midwifery to those possessing the necessary professional qualifications. Further, that the difficulties became greater as the volume of unqualified practice increased, and suggested that, if it became necessary to regulate the practice of opticians, much was to be gained by taking the necessary step while the problem was still manageable. The arrangements for Ophthalmic Benefit under the Insurance Act are next set out; with these our readers should be fairly well acquainted. A paragraph follows commenting on the confusion caused by the variety of titles used by opticians, the marked variations in the standards required by the various optical organizations, and the comparative worthlessness of some of their diplomas. The question of the effect of the sale of cheap spectacles is not considered worthy of further inquiry in view of the opinion held by the Committee as to the nature of any register which could be established in this country. Provision is made by law for the registration of opticians in parts of Canada,

Australia, in most of the United States of America, and in Jamaica. The Committee state: "From the evidence which we have received it seems to be agreed that this legislation has been effective in putting down the unregulated sale of spectacles, and has had the effect of raising the standard of qualification of opticians, and from this point of view we may conclude that the Acts have had a beneficial effect. We have not, however, been able to obtain any very clear evidence as to whether this legislation has resulted in an increased reference to medical practitioners of cases of defective sight which require treatment by medical means rather than by the provision of glasses. In any event we are not satisfied that the conditions are comparable." Part I concludes with the following statement as to the nature of the present Bill. "The Bill is not prohibitive in the sense that it would exclude unregistered opticians from continuing to practise, as is the case in most of the other countries to which our attention has been called. It proposes to leave to a board the duty of deciding the qualifications which would entitle an optician to be placed on the register, and, theoretically at least, it would be possible for a great number of existing opticians to be refused admission to any register which might be set up under the Bill."

Part II of the Report is subdivided into three sections. Section I deals with the relationship between the public on the one hand and oculists and opticians on the other, and the kind of register which could be set up; Section II with the limitations which would have to be placed on the practice of such registered opticians; and Section III with the final conclusions on the main issue.

The subject matter of Section I is apt to be somewhat neglected and the importance attached to it throughout the Report is a very satisfactory feature. It is stated that in the best interests of the patient the examination of his eyes should, if possible, be carried out by an oculist. This is unfortunately only possible in the case of hospital patients, elementary school children, and private patients who can afford to pay the necessary fees. The approved societies are unable to find a fee of one guinea for every insured person who complains of defective sight and it is, therefore, obvious that for a large section of the community the optician may be said to be recognized as the natural person to be consulted in cases of eye trouble, while the oculist is regarded as a luxury. Further, the Committee state that they have every reason to believe that of that section of the community who have their sight attended to privately, large numbers adopt the same attitude. It is only natural, therefore, that there should arise a demand that a register should be set up whereby both approved societies and individual members of the public may be enabled to differentiate between one class of optician and another, and be safeguarded from imposition.

The point at issue is whether the manifest advantage to the public of producing some sort of order out of the present chaos outweighs the disadvantage of affording State recognition to what, at best, can only be a partial service.

The next point deals with the problem of admission to any such register, a register which the Committee wisely judge could not be made prohibitive. "For example should aspirants for admission be compelled to satisfy the Board either individually or with reference to a diploma already granted, that they have the capacity not necessarily to diagnose but to detect the existence of any condition of the eye which would render the prescription of glasses at best a mere palliative, and at the worst a positive danger." In this connection the Committee, while not prepared to lay too much stress on percentages, are of the opinion that the number of cases in which an apparently simple error of refraction is complicated by other ocular disease is greater than has been supposed to be the case. The Committee feel obliged to say that they are not satisfied that there is any training for opticians sufficiently thorough to avoid the danger which is involved in a little medical learning. The Joint Council of Qualified Opticians, which is regarded as representing the highest standard at present obtained, draws its members from two other bodies, the British Optical Association, and the Spectacle Makers Company. Of these two, the former examine their candidates in the detection of disease while the latter do not. Further, the possible effect of any register on the business of the pure dispensing opticians requires serious consideration. At the least, in their defence, a supplementary register of dispensing opticians would be essential.

Section II deals with the necessary limitations on the practice of registered opticians. In the first place the use of drugs would have to be prohibited, a restriction which would render the recognition of intra-ocular disease almost impossible in cases with very small pupils. Even an experienced ophthalmologist would hesitate in giving an opinion on the state of the macula without, in the majority of cases, dilating the pupil. Further, as regards treatment other than that by glasses the Committee hold the opinion that this should be absolutely prohibited, as also the use of any title which would confuse or mislead the public as to the function of the registered persons. Finally, as regards advertisement it is generally recognized that the establishment of a register on a professional basis involves abstention from advertising. The use of advertisement, however, would be still open to the unregistered practitioner.

The final section gives a summary of the conclusions reached and is here reproduced in full, since any further abbreviation is hardly practicable.

"40. At this point we think it advisable to sum up the conclusions which we have reached in the two preceding sections. We have seen that the functions of even the best qualified opticians should be restricted to the use of mechanical means for the correction of errors of vision, and that in the best interests of the patient the responsibility for any examination of the eyes should be upon an oculist, who, in addition to having access to all the resources of the skilled optician, can bring to bear the whole of his medical experience either in deciding that it is possible to determine the absence of disease or, on the other hand, to recognize and to treat any diseased condition that may be present. Opticians cannot, therefore, provide more than at best a partial service, but in view of the fact that large sections of the community in present circumstances do not avail themselves of the services of oculists and of the fact that the public are not in a position to recognize which are the most competent opticians, there is a *prima facie* case for setting up a State register in order to produce some sort of order out of the present chaos.

41. As, however, a considerable proportion of cases of defective vision are not cases of mere refractive error but require treatment other than, or in addition to, the provision of spectacles, it follows that the very prescription of spectacles involves an implied decision that no other treatment is required; and we think that this consideration must necessarily govern the standard to be set for admission to any register. After a careful review of the facts regarding the training of opticians as a whole, we have been forced to the conclusion that it would not be in the public interest to set up a prohibitive register which would involve the admission of practically all opticians who were able to show that they have been conducting *bona fide* businesses. At the same time the setting up of a non-prohibitive register would be useless if not dangerous unless it were made a condition of entry that every candidate should prove to the satisfaction of the Board his ability to exclude the possibility of the existence of disease before prescribing spectacles. We are not satisfied that even those opticians who are most highly qualified in all other respects are sufficiently trained in this respect.

42. Further, the setting up of a register of sight-testing opticians would necessitate the separate registration of opticians who undertake dispensing only.

43. In Section II we find that it would be necessary not only to impose restrictions on registered opticians in the way of treatment, of advertising, and of using confusing or misleading titles, but that it is imperative that they should be prohibited from using drugs. Such a restriction would in effect severely limit the classes of patients whom the opticians would be capable of treating.

Final conclusions

44. In view of all these conclusions we are convinced that the setting up of a State register of sight-testing opticians is not in itself a desirable policy. There remains, however, the question whether it is nevertheless necessary, having regard to existing circumstances, to adopt this expedient in the public interest. In our opinion the answer to this question depends on how far the medical profession is likely to be able to make the services of oculists available for persons in those sections of the community for whom at present they are, for economic reasons, not available.

Prospect of the extension of the services of oculists

45. Whether it is as the result of the establishment by approved societies of ophthalmic benefit, or of the question of registration becoming acute, or of the increasing competition of better trained opticians, or merely of the greater public recognition of the importance of defects of vision, we are satisfied that there exists a movement on the part of the medical profession to provide treatment by oculists on terms which will make that treatment much more readily accessible to the public. We are assured, for example, that so far as insured persons are concerned, negotiations are at present being conducted by the British Medical Association with a view to the establishment in all the more populous districts of clinics or other schemes by which the services of oculists would be made available at fees within the reach of approved societies, having regard to the limited funds available for ophthalmic benefit.

Number of oculists available

46. Moreover, we are satisfied that in recent years an increasing number of medical men, and particularly the younger men, have been making a special study of ophthalmology; also, that there is good reason to believe that a supply of oculists, sufficiently well distributed to meet reasonable demands, will be forthcoming. The setting up of a State register of opticians would not encourage and might indeed retard these movements. We feel that it would be a retrograde step on the part of the State to do anything to discourage the provision of the best form of treatment for the greatest possible number of patients.

Future of opticians

47. It has been claimed, probably with truth, that the setting up of a State register would incite those responsible for the training of opticians to raise the standard of qualifications, but we see no reason why the improvement in methods of training

which has been made in the last 10 or 15 years should not be maintained, though no register is set up. Whether the register is set up or not we feel sure that numbers of the population will resort to opticians in the future, as they have done in the past, and we think that the natural competition which will be engendered by the movement on the part of the medical profession to which we have referred will have the effect of raising the standard in both classes of practice. Further, in view of the large numbers of opticians who are undoubtedly capable refractionists, we consider it would be beneficial in the public interest if use could be made of their services in that capacity in collaboration with and under the control of oculists, and we commend this view for consideration in connection with the negotiations referred to in paragraph 45.

48. While we have been forced to conclude that it is not in the public interest that a State register of opticians should be set up, we desire to emphasize that one of the principal reasons on which we base this opinion is our view that it is possible and probable that the medical profession will be able to provide insured persons entitled to ophthalmic benefit with the services of oculists at an early date, and at fees within the limit of the funds from time to time available to approved societies for this purpose. We hope, also, that such a service will be extended to the non-insured population. If, however, for any reason, these hopes are not fulfilled within a reasonable time we do not wish our Report to preclude the possibility of a reconsideration of the question in the light of the circumstances then existing."

The two minority reports, the first signed by Messrs. Aves, Barker and Houghton, and the second by Mr. Rhys J. Davies are both in favour of a registration Bill on the proposed lines. The first states that "We consider it, therefore, unreasonable for the Majority Report to conclude that a State register is almost inevitable and then to ride off from this conclusion on the strength of an unexplored promise from one of the interested parties (traditionally jealous of subsidiary professions bordering upon their own) a promise that, even if taken at its face value, does not hold out any prospect which in the light of the accumulated evidence before us can be regarded as giving substantial relief to the serious needs of the situation. . . . We conclude, therefore, that the case for the regulation of the practice of optometry by means of a State register is well supported, and that the Committee incurs a serious responsibility in making an indeterminate report. . . . A *non possumus* attitude now that the issue has been thus prominently raised will certainly give countenance to the idea that there is no intention whatever to interfere with undisciplined practice, and this in itself would be little short of a public disaster."

Mr. Rhys J. Davies, in the second Minority Report, while in agreement with many of the statements in the Majority Report, draws attention to the usual effect of registration in other professions in increasing fees and costs in general to the customer, and recommends that definite precautions should be taken to prevent the imposition of exorbitant charges for sight-testing and appliances. He considers that there should be at least two representatives of the approved societies on the Registration Board to represent the interest of the consumers. He concludes by saying that: "the register on its first compilation should include, in addition to those of undoubted qualification and training, a limited number of those with a wide experience of sight-testing and the sale of appliances, but who are now without other qualifications. There should, however, be a time limit to the operation of this principle; and, say as from January 1, 1930, a universal standard should be set before further names are added to the register."

E.E.H.

II.—OPTICS AND REFRACTION

(1) **Bretagne, M. P. (Nancy).—Micrometric ophthalmoscope lens. (Loupe ophtalmoscopique micrométrique.)** *Ann. d'Oculi.*, CLXIII, p. 192, 1926.

(1) **Bretagne,** as a result of the frequent employment of the graduated ocular in a corneal microscope, was moved to devise the following method for measurement of changes observed in ophthalmoscopy. A scale in millimetres for an extent of three centimetres is engraved on the lens used in indirect ophthalmoscopy. This scale is placed somewhat eccentrically so as to allow of a clear view of the fundus in ordinary examination and also to allow of measurement of any part of the area of fundus in view by simple rotation of the lens. Bretagne emphasizes the fact that by this method actual measurement is not obtained, but records can be taken which are of value in particular cases. The size of an image visible in the fundus oculi varies with: (1) the focal length of the ophthalmoscope lens; (2) the refraction of the observed eye; (3) the distance of the lens from the nodal point of the eye (in ametropes); (4) the distance of the lens from the observer.

In general a lens of 13 dioptres is used; the distance of this lens is usually its focal length (77 millimetres for 13 dioptres); that is the position which gives the largest field of view. The distance at which the observer holds the lens from his eye depends upon his habit and his anatomical structure. Although the image

of the fundus and the scale engraved on the lens are not in the same plane, it is claimed that they appear to be in focus at the same time.

HUMPHREY NEAME.

(2) **Dupuy-Dutemps, L. (Paris).—Modifications of the sensation of relief (or prominence) produced by decentred spectacle lenses and by prisms in binocular vision. (Les modifications de la sensation de relief produites par les verres de lunettes décentrés et par les prismes dans la vision binoculaire.)** *Ann. d'Ocul.*, Vol. CLXIII, p. 673, 1926.

(2) **Dupuy-Dutemps** describes and explains a fact which is little known with reference to stereoscopic vision. The fact is one of considerable importance, in that one who is conversant with it is able to translate certain symptoms of which a patient may complain in the use of spectacles. The fact is that on looking through two prisms placed base inwards at a vertical rod (or line), an observer sees the rod apparently curved with its convexity towards him. In the case of a plane surface he sees this surface apparently domed. If the prisms be reversed and placed with their bases outwards, such a surface will appear to be hollow. A similar phenomenon is observed if convex lenses are placed in front of the eyes and displaced inwards or outwards respectively, owing to the prismatic effect of decentration. The truth of this is very easily tested by using two prisms of four dioptres and looking at a plane surface near at hand, provided that the observer possesses good stereoscopic vision. An opposite result is of course produced with concave lenses. The reason for this stereoscopic anomaly is that a prism, base to the left, in front of an eye, makes vertical lines appear concave to the right, and a prism in the reverse direction makes such lines appear concave to the left. The fusion of the two images in stereoscopic vision gives the appearance of prominence or relief. Cylinders with axes vertical behave in a similar manner. The sensation of distortion is increased with lenses of higher power and with greater degrees of decentration. It is sometimes a cause of discomfort in patients when for the first time they use spectacles with decentred lenses or with prisms for defective convergence. Some can never accustom themselves to the new conditions. The knowledge of these facts enables a diagnosis to be made as to errors of centration of lenses and the correction required.

HUMPHREY NEAME.

(3) **Sedan, J.—A note on inflammatory myopia. (Note sur le myopie inflammatoire.)** *Ann. d'Ocul.*, CLXIII, p. 358, 1926.

(3) **Sedan** reports two cases, a man, aged 25 years, and a boy, aged 13 years, in whom transient myopia developed as a result of

acute iritis. In the former the cause was secondary syphilis, in the latter a severe attack of fever of fifteen days' duration with gastro-intestinal symptoms which preceded the iritis and subsided four days previously to its onset. In each case there had been previous examination by an oculist. In the man the affected eye had been emmetropic with vision 10/10 while the fellow eye was amblyopic with a central corneal opacity. The boy had been pronounced emmetropic by a school oculist three years before. The fellow eye was removed on account of a penetrating wound one year after the school examination. In each case atropine was used, and retinoscopy revealed myopia of -2.0D. and -3.5D. with vision 10/10 and 9/10 respectively. In the first case the myopia had completely disappeared two months later, as verified by retinoscopy. Vision was 10/10 without a lens. In the second case, five months later the myopia was reduced to -2.75D., and in a further twelve months to -1.5D. This amount of myopia was still present a year later. As a possible explanation of the persistence of 1.5D. of myopia (after recovery from as much as 3.5D.) it was found that there was a family history of a small amount of myopia. The not very convincing explanation suggested is that a transient paralysis of the peripheral muscle of accommodation (*du muscle de l'accommodation lointaine*) takes place and not a spasm of the proximal muscle of accommodation (*accommodateur de près*).

HUMPHREY NEAME.

(4) **Bohenberger F. (Leipzig).—A case of double refraction (Ueber einen Fall von zweifacher Refraktion.)** *Klin. Monatsbl. f. Augenheilk.*, May, 1926.

(4) **Bohenberger** records the case of a boy, aged 12 years, who showed double refraction in one eye. The aspect of the eyes suggested high myopia and actually skiascopy revealed about 15D. of myopia. The right eye was amblyopic but the left read 6/20 without any correction and without screwing up his eyes. Concave lenses at first diminished the acuity and then improved it till eventually with -14D. sph. it reached 6/15. The same acuity was however given with +3.D. sph. Examination under atropine and pilocarpine gave substantially the same readings. J.1. was read without any glass at a distance of 8 cm. The same result was obtained with +15D. sph. Careful examination showed that the cause of this double refraction lay in the cornea. Focal illumination revealed several corneal maculae, one of them very delicate and circular in outline lay a little below and outside the apex of the cornea, that is exactly in Aubert's optical zone. By transmitted light it had a dark ring with a clear centre, looking like a button in the centre of the red light of the pupil. Con-

siderable parallax was noted when the retinal vessels were seen through the centre and outside the central button. The keratoscope gave no further information regarding the nature of the opacity, but the slit-lamp at once gave the required information. When the cornea was examined with the narrow beam, using a series of optical sections, it was seen that the anterior surface of the cornea was slightly flattened but that the posterior surface bulged inwards. There was a cicatricial opacity in the anterior lamellae of the cornea. The use of a contact glass showed that the correction of the myopia was due to the flattening of the anterior surface of the cornea.

T. HARRISON BUTLER.

(5) **Godard, P. J. E.—The quadruple stenopaic hole and conditions of ametropia.** (**Trou quadristénopique et amétropies.**) *La Clin. Ophtal.*, September, 1926.

(5) This is quite an interesting and very clearly written article dealing with an elaboration of the ordinary Scheiner experiment. It is doubtful whether the findings obtained by **Godard** are of real practical value to the clinician, though to the dabbler in subjective experimentation the explanations may be useful. Put as shortly as possible, if an ametrope looks through two or four minute holes in a card at a white disc on the wall or on the table he will see two or four discs and if the card be very slightly moved laterally the two or four spots or discs will execute lateral movements in the same sense. If the same experiment be tried in an emmetrope only one disc will be seen and no lateral movements thereof on moving the card. The author gives the explanation, which hardly needs to be stated, that in the ametrope the retina cuts the bundles of rays before or behind their focal point and so causes multiplication. With regard to the lateral movements the explanation may be given in the author's words: "It is well known that the ordinary stenopaic opening corrects slight ametropia by cutting out the marginal rays of the cornea. This takes place when the hole is placed exactly opposite the centre of the cornea. But, if it is not placed exactly in the centre it will continue to sharpen the images, but . . . . this is accompanied by a slight lateral displacement in the retinal projection of the image, so that while the object appears clear it is also seen slightly to one side of the point at which it appears when the hole is exactly central." In these experiments the author has employed a trouser button to provide the four symmetrically placed holes. No one with any sense of humour can fail to visualize the unenviable dilemma of the enthusiastic and excited scientist who has no spares.

ERNEST THOMSON.

III.—MISCELLANEOUS

(1) **Gérard, Georges (Lille).—Collapse of a frontal sinus of the spacious type. (Enfoncement d'un sinus frontal, de la variété des grands sinus.)** *La Clin. Ophtal.*, December, 1926.

(1) This article by **Gérard** is interesting especially from the point of view that our knowledge of the frontal sinuses is comparatively recent, but it is not easy to epitomize on account of the necessarily large amount of quotation involved in the original. The author points out that this knowledge practically dates from 1891 when Montaz, of Grenoble, published a little book of eighteen pages containing an accurate account of these sinuses. The reviewer has some reason for supposing that Gérard is correct, for he well remembers about 1892 assisting a friend in an operation on the frontal sinus which was undertaken with considerable hesitation and which resulted in a very prolonged healing. The operation, if the reviewer remembers rightly, was then considered an unusual one. Gérard points out that these sinuses do not appear till about the end of the first year and do not attain their full development until 15 to 20 years. As a rule the anterior wall is much thicker than the posterior but sometimes it is extremely thin. The thickness of the walls is inversely proportional to the size of the cavity, the smaller the cavity the thicker the walls, but, and here is the point, the less is the anterior pole of the cerebral hemisphere protected. The special interest of Gérard's case lies here, for the patient, an elderly man, was apparently saved from severe damage to his brain by the fact that he had large thin-walled sinuses. He had been murderously attacked and had the anterior wall of one sinus pushed in, resulting in tremendous bruising and emphysema of the face, but recovered without damage either to his brain or his visual apparatus. There is a considerable amount of information in this short article which is illustrated with anatomical schemata based on skiagrams, and has a bibliography appended.

ERNEST THOMSON.

(2) **Kemler, Joseph I. (Baltimore).—Ivory implant after enucleation.** *Amer. Jl. of Ophthal.*, January, 1927.

(2) **Kemler** considers the various substances which have been used as implants after enucleation to be unsatisfactory. They have a strong tendency to be extruded later, while glass has the additional disadvantage of being liable to break, and paraffin to change its location. Organic substances, *e.g.*, fat, fascia lata, and cartilage undergo absorption and in course of time leave only an insignificant trace of their presence. Ivory, however, is very

satisfactory. It is well tolerated by the surrounding tissues, is not absorbable and cannot break. The prothesis is prepared by taking a one-inch cube of ivory, and rounding off all corners and edges with an electrically driven carborundum wheel until the shape is approximately spherical. A report is given of one case in which ivory was used, with a satisfactory result, though the author does not state how long the case was under observation.

F. A. WILLIAMSON-NOBLE.

BOOK NOTICE

Handbuch der biologischen Arbeitsmethoden. By EMIL ABDERHALDEN. Abt. V. **Methoden zum Studium der Funktionen der einzelnen Organe des tierischen Organismus.** Teil 6, Heft. 7. **Methoden zur Bestimmung des intraokularen Druckes; Methoden zur Untersuchung des intraokularen Flüssigkeitswechsels.** By E. SEIDEL. **Die Technik der Untersuchung des extramaculären Sehens.** By H. LAUBER. Pp. 231 with 57 illustrations. Urban u. Schwarzenberg, Berlin and Vienna, 1927.

The monumental composite work dealing with the practical methods of investigation employed in every known department of biological science is gradually appearing in numerous volumes under the general direction of Professor Abderhalden. The fifth section of the work deals with the chemical, physico-chemical, and biological methods used in the study of the functions of the organs in the animal body, the sixth part of which concerns itself with the eye. This is divided into seven divisions, the sixth of which has now appeared.

The first part of the volume is written by Professor Seidel of Heidelberg, and discusses the methods of measuring the intra-ocular pressure, and of investigating the intra-ocular fluids. In dealing with the first of these, the various types of tonometers and manometers which have been used from time to time are described and figured, the description covering most of the experimental work which has been done on the intra-ocular pressure. For clinical purposes most attention is given to the tonometer of Schiötz. A similar review follows of the technique employed by the many investigators who have studied the problems of the nature of the aqueous humour, its composition, and the mechanism of its circulation. Seidel has himself done a large amount of work on this subject, a clear account of which is included; he is a strong

advocate of the secretory theory of the origin of the aqueous humour; and although this view is strongly upheld in places, perhaps with some degree of bias, alternative views and the experimental findings in support of them are given mention. The remainder of the volume deals with the investigation of extra-macular vision. Professor Lauber, who is responsible for it, gives an account of the various methods of perimetry, the investigation of the fields for colours, the light sense and colour sense of the peripheral retina, and other cognate subjects. As is usual in German works of this description the task is done with commendable thoroughness.

CORRESPONDENCE

To the Editor of THE BRITISH JOURNAL OF OPHTHALMOLOGY

SIR,—May I suggest a special way of suturing the graft, as described in the interesting article by Dr. A. MacRae: "Webster's Operation for Entropion of the Upper Lid." If the tarsal plate be very degenerated I excise it and if I have to deal with a grossly swollen tarsus and desire to increase the effect of the operation for the entropion, I also do a transplantation of mucous membrane from the lip on to the wound.

Shimkin in 1913 proposed a very simple way of securing a good position and protection for the conjunctiva in Kuhnt's operation for excision of the upper fornix. I applied this method for fixation of the graft without any difficulty.

The best suture material is very fine silk (No. 00) with a fine needle on each end of the thread. Keep the lid everted, put the graft on the bare area, and insert the needle in the graft and straight through the lid on to the skin surface. At a distance of 0.5 cm., the other needle is inserted in the same way and the suture is then tied on the skin surface of the lid over a piece of gauze. By inserting these sutures at the margins of the graft contact with the cornea is avoided, or, if it occurs, some vaseline will make the cornea perfectly safe. The graft will stand as many sutures as is necessary. The protection and position of the graft are assured by these sutures. In three days the silk can be removed without everting the lid or disturbing the graft by simply cutting the suture on the skin surface of the lid and withdrawing it.

Yours faithfully,

N. PINES.

LONDON,
February, 1927.

TRACHOMA

To the Editor of The British Journal of Ophthalmology

Sir,—In the February number of the British Journal of Ophthalmology you publish a number of abstracts on trachoma amongst which are two on the work of Noguchi, Posey, and others on trachoma amongst the Indians of the South-West of America. Noguchi has apparently isolated, cultivated, and inoculated an organism which produces a condition exactly similar to the trachoma found amongst American Indians, but the histological appearance of the trachoma amongst the American Indians and the inoculated conjunctiva in monkeys and anthropoid apes differs considerably from the histological appearance of trachoma as found in this country, and in emigrants to this country from Europe. The principal difference is that the follicles in American Indian trachoma consists almost entirely of epithelioid cells surrounded by a comparatively small ring of lymphocytes. Although one or two epithelioid cells are usually found in follicles showing advanced changes in European trachoma, the follicles are made up of lymphocytes and plasma cells, most of the latter of which are in a state of degeneration. The infiltration and follicular formation also seems to be much more discrete than is found in European trachoma. It is rather suggestive that there is more than one form of infection which causes the disease. So far Mr. McCartney, Research Bacteriologist to the Metropolitan Asylums Board, has been unable to isolate the Noguchi organism, although in one case a somewhat similar organism was found, but it did not yield agglutination test with the blood serum from trachomatous cases.

Yours truly,

M. S. Mayou.

London,
2nd February, 1928.

OBITUARIES

BASIL THORN LANG, M.A., B.Ch.Cantab., F.R.C.S.Eng.

Basil Thorn Lang was the only son of Mr. William Lang, Consulting Surgeon to the Royal London Ophthalmic Hospital, and Consulting Ophthalmic Surgeon to the Middlesex Hospital. He was educated at Abbotsholme, and at Trinity College, Cambridge, where he graduated in 1902 with First Class Honours in

the Natural Science Tripos, and completed his general medical education at St. Bartholomew's Hospital.

Following in the footsteps of his father he specialized in ophthalmology, working as Clinical Assistant at Moorfields, and first as Clinical Clerk and later as Ophthalmic House Surgeon at St. Bartholomew's. In order to gain operative experience he went to India for six months and worked under Colonel Henry Smith at Jullundur and under Colonel Elliot at Madras, and became a skilled and dexterous operator. At the outset of the War he at once joined the R.A.M.C. and served practically continuously in France throughout the War. During the earlier period he devoted his energies to X-ray work, and by means of his brilliant inventive gifts combined with his intimate technical knowledge he devised and had built in France the first mobile X-ray unit for use in the front areas. When the King met with his serious accident, Lang and his unit were immediately sent for to X-ray His Majesty. Shortly after this he had an accident which was followed by a serious illness and in consequence he was invalided home for several weeks: he probably never completely recovered. On returning to duty he became Ophthalmic Specialist and did valuable work both at Rouen and Etaples. After the War he was appointed Assistant Surgeon to the Western Ophthalmic Hospital and Lang Research Scholar, Royal London Ophthalmic Hospital, posts which he held till his election to the staff of the latter in 1920.

Any mere summary of his medical achievements gives no clue to his versatility. Having a broad grasp of the principles of physics as well as a gift for constructive detail, he understood the working of motor-cars, the telephone, the wireless, etc., as well as the various optical instruments. He enthusiastically welcomed any clever new invention—and he himself devised many—several of which he patented, one of the most notable being a long distance range-finder.

As an Ophthalmic Surgeon he had original methods both of treatment and operating and showed considerable resource, but he had not attained to that quality of judgment which made his father so deservedly sought after both as a clinician and a consultant. He devised several ingenious ophthalmic instruments, chiefly various forms of perimeter and an operating lamp, and he delighted in any new type of apparatus which extended to the ophthalmic surgeon further powers of observation. His book "The Routine Examination of the Eye" (an amplified edition of his father's excellent handbook "The Methodical Examination of the Eye"), and his papers on perimetry and scotometry all show his capacity for observation and originality of thought.

He was one of the most generous of souls; no trouble was too great for him to take to help a friend and he took endless pains

with the juniors who came to work in the clinic to make the hard places of ophthalmology seem easy. He was always willing to impart his knowledge to others.

Basil Lang was married only eleven months ago and all who knew him will offer his widow, his father, and sister their deep sympathy in the irreparable loss they have sustained.

PROFESSOR HJALMAR AUGUST SCHIØTZ, M.D.

ON November 30, 1927, Professor HJALMAR AUGUST SCHIØTZ was attacked by cerebral haemorrhage, while engaged in the task of adjusting a series of new tonometers. He died on December 8, without having regained consciousness.

Hjalmar Schiøtz was born on February 9, 1850, in Stavanger, Norway. As late as Thursday, November 24, at the Oslo Ophthalmological Association, he delivered, in his lucid and comprehensive style, a demonstration-lecture on the laws governing the movements of the skiascopic shadows.

Hjalmar Schiøtz had an extensive general medical education, previous to devoting himself to the science of ophthalmology. After qualifying in 1877, he went through assistant duty at different hospital-divisions and with a private practitioner in Brevik. Subsequently he worked abroad, first at Vienna, where he stayed for half a year with Arlt; and secondly, at Paris, where he stayed for one and a half years and became *Directeur adjoint* at the ophthalmological laboratory of the Sorbonne for a period of about one year, under the supervision of Emile Javal. This co-operation, termed by Javal himself as *les plus meilleurs jours dans ma vie*, proved to be of great importance for Schiøtz. Together they designed the well-known apparatus for ascertaining the corneal astigmatism. For a considerable period, however, it carried Javal's name only. Due, none the less, to his reference to the co-operation—the mathematical part of it being mainly the work of Schiøtz—made at the Tenth International Ophthalmological Congress in Lucerne, 1904, where an improvement of the instrument was demonstrated, the apparatus was finally to become generally known under the joint names of both designers. In 1881, Schiøtz returned to Christiania, now Oslo. During the next three years he was Clinical Chief at Surgical Section B. of the Government Hospital and later he was the head of the Surgical Policlinique. At that time Division B. had surgical and ophthalmological service in common. His senior was Professor Johan

Hjort, known as the initiator of the open wound method after cataract operations. This joint division, as such, had an important bearing on Schiøtz's further development. His pre-eminent dexterity in regular ophthalmic operations and especially in plastic eyelid operations was due perhaps mainly to this joint work.

In 1883, he took his M.D. with a thesis: "On some optical corneal characteristics." During the illness of Professor Hjort in 1898-9 Schiøtz took charge of his division, which by this time covered only ophthalmic affections. On December 12, he was made the head surgeon of the Government Eye Hospital, and on June 15, he was appointed Professor of Ophthalmology, retaining the chair until September, 1921, when he retired under the age clause.

Hjalmar Schiøtz had a great versatility of mind, his powers being comprehensive. In the first place he was the born clinician with an open mind for the essential features of any disease. He had his special forte in sketching a particular syndrome in a few words, thus conveying it to the minds of his assistants and pupils. However, he was scarcely such a good theoretical lecturer for the young students. Everything clinically that contributed to rapid diagnosis of a case caught his particular interest. This, combined with a pronounced technical turn and a superior mathematical gift, made him a pathfinder, occupying his spare time with the construction of instruments, designed to facilitate the diagnosis and to further the therapy. His work with Javal has been mentioned; he was also the inventor of several other ophthalmic instruments, notably a self-registering perimeter.

The all-important instrument which has been the means of erecting him a *monumentum aere perennius*, is the tonometer, first demonstrated to the Norwegian Medical Society on May 12, 1905. In spite of numerous attempts to improve it, made from different parts of the world, the original Schiøtz has so far been able to maintain its reputation of being the most dependable, handy, and efficient instrument known for its special purpose. It has, therefore, become a most essential aid to ophthalmic surgeons the world over in their fight against glaucoma.

Although Professor Schiøtz, as previously mentioned, was a prominent surgeon, he, however, never went cheerfully to a serious operation, and few, not even those who had worked with him for years, were aware of the depression which haunted him before entering the operating room. But just this sensitiveness, together with his fine and noble character, as also the example which his predecessor, Professor Hjort, had given in his treatment of him as well as of the other assistants and of the patients, contributed to make him the exceptionally painstaking, considerate, and warm-hearted physician, colleague and friend,

beloved by all who came in touch with him and willing, at any time, to give advice and help. Even after he had retired from his private practice in 1921, his vast experience was repeatedly called upon by his colleagues. Characteristic of him was his reply to a young ophthalmic surgeon. A patient had got a panophthalmitis after an otherwise uncomplicated cataract extraction in his single eye. The doctor sent in his distress for his old chief, who met him with the words: "Call for me at any time. I know what Professor Hjort did for me when I was young!" University students, as a rule, are pitiless critics, who quickly detect any weakness on the part of their teachers. Characteristically the undergraduates of Professor Schiøtz nicknamed him "Alfader" (All-father) the very name the old Norsemen attached to their foremost mythological god "Odin" (Woden) meaning not to designate him as an imperious Titan, but as the all-embracing father. "Alfader" was meant to stand for the lenient gentleness radiating from him to his fellow beings.

Professor Schiøtz was a member of numerous domestic and foreign medical societies. He has published several treatises and scientific works in Norwegian, including text-books for undergraduates in English, French, and German. He also was in possession of a series of decorations. Thus, about a year ago, he was appointed Commander of the First Class of the Order of St. Olav for his introduction of the tonometer in the treatment of glaucoma. He had been Knight of this Order for a number of years.

HARALD G. A. GJESSING.

BROWNLOW RIDDELL

BROWNLOW RIDDELL, O.B.E., M.D., died suddenly in Glasgow on January 19, 1928. He had a long connection with the Glasgow Eye Infirmary and had been full surgeon since 1919. Riddell was associated with the late James Hinshelwood, in his hospital work and in his investigations of nervous disorder, and he had himself made a special study of eye symptoms in the early diagnosis of disseminated sclerosis (*Trans. Ophthal. Soc.*, 1924). During the war Riddell acted as Medical Superintendent of Stobhill Hospital, Glasgow, and the success of this hospital was largely due to his efficient organization. For his war-time services he was awarded the O.B.E.

NOTES

Appointments

Mr. W. STEWART DUKE-ELDER has been appointed Assistant Surgeon to the Royal London Ophthalmic Hospital.

Mr. A. SOURASKY has been appointed Assistant Ophthalmic Surgeon to the London Jewish Hospital.

Dr. GEORGE YOUNG has been appointed Hon. Ophthalmic Surgeon to the Clacton and District Cottage Hospital.

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Royal London Ophthalmic Hospital Dinner and Annual Report

THE Annual Dinner of Past and Present Students of the Royal London Ophthalmic (Moorfields Eye) Hospital was held at the Langham Hotel on Wednesday, February 8, 1928. Sir Wilmot P. Herringham, K.C.M.G., was in the Chair and 80 students and guests were present.

Among the guests were: Sir John Rose Bradford, K.C.M.G.; Sir James Berry; Vice-Admiral Arthur Gaskell, C.B.; Sir Mathew Fell, K.C.B.; Professors Elliot-Smith and H. Hartridge; and Mr. Ernest Clarke and Mr. Theodore Luling.

The various toasts were given by the Chairman, Sir John Parsons and Sir William Lister, and were responded to by Sir John Rose Bradford, Mr. Theodore Luling, Vice-Admiral Gaskell and Mr. Goulden.

During the evening the Dean (Mr. Goulden) presented the following report:

The number of new students that had attended the School during the past year was 120 and the number attending the practice of the Hospital, 216, practically the same as last year.

During that time 386 lectures had been delivered by members of the Staff with the assistance of Mr. Hume, the lecturer in Anatomy and Mr. Brinkworth in Physics.

Among the successes gained by students last year two received the Diploma of F.R.C.S. of Edinburgh in ophthalmology.

For the First Part of the D.O.M.S. 43 students, 46 per cent. of the total list, were presented and 28 passed.

For the Second Part of the D.O.M.S. 42 students, 70 per cent. of the total list, were presented and 26 passed.

A new departure has been made in the past year by obtaining the service of lecturers outside the hospital to give courses of

lectures, or occasional lectures, on subjects of which they are acknowledged authorities.

In the autumn Dr. Traquair of Edinburgh gave a course of lectures on "Perimetry."

Professor Hartridge gave two occasional lectures on "The Resolving Power of the Eye," and again there were good attendances.

In the coming term Professor Elliot-Smith will give a course of six lectures on "The Optic Connections in the Brain," and Dr. Kerr, late Principal Schools Medical Officer of the London County Council, will give two occasional lectures on subjects related to education of the partially sighted.

If these efforts are appreciated it is hoped still further to extend the usefulness of the School, and so that those outside the School may attend we are now able to find lecture accommodation for about 200 by adapting a portion of the Out-Patients' Department.

Several changes by retirement and death have to be recorded on the teaching staff.

Dr. Gordon Holmes retired last summer. He had for several years given valuable lectures in medical ophthalmology.

Mr. Hudson retired in January. For many years he had taken classes in operative surgery, than which none could be better, and he will be able to continue with these classes in the future.

Mr. Basil Lang died in January.

Mr. Hillman was forced to give up the lectureship of anatomy that he has held so successfully during the past six years.

The new-comers are Dr. Adie, who had succeeded Dr. Gordon Holmes; Miss Ida Mann; Mr. Duke-Elder.

Mr. Hume, from St. Bartholomew's succeeded Mr. Hillman as lecturer in anatomy.

* * * *

Corrigendum

IN the article on Roger Bacon in the January number, page 12, the opinion is expressed that he must have had a working knowledge of Arabic. Dr. Charles Singer has called our attention to the fact that this is not correct. He states that Bacon wrote his commentary on the *Secretum Secretorum* from a Latin translation of the Arabic made by Johannes Hispalensis, a Spanish Jew of the twelfth century. It is also needful to point out that both Philip and Gilbert de Columbariis (footnote, page 3) were barons in attendance on Henry II, and each must have been at least one generation earlier than Roger Bacon. It is, of course, not unlikely that one

of their sons, if they had any, may have had the same name as his father, and so might have been of the same generation as Roger Bacon.

* * * *

Gifford Edmonds Prize

AN extra Gifford Edmonds Prize of £100 for the best essay on a subject dealing with ophthalmology involving original work will be awarded in December, 1929.

The subject for this essay is "Central Scotoma: its Pathology and Clinical Significance."

Essays should be sent to the Secretary, Moorfields Eye Hospital, City Road, E.C.1, from whom any particulars may be obtained.

The subject for the current essay to be sent in in December, 1928, is "The Causation and Differential Diagnosis of Proptosis."

The prize is open to all British subjects.

* * * *

H.R.H. the Prince of Wales recently honoured Messrs. Curry and Paxton by visiting their works in Camden Town. The Prince was accompanied round the works by the Governing Director, Mr. George Paxton, and by several ophthalmic surgeons.

FUTURE ARRANGEMENTS

1928

March 2.—North of England Ophthalmological Society (jointly with the Midland Ophthalmological Society) at Sheffield.

March 9.—Royal Society of Medicine, Section of Ophthalmology (Clinical Meeting).

March 30.—North of England Ophthalmological Society at Liverpool.

April 19-21.—Annual Congress, Ophthalmological Society of the United Kingdom at the Royal Society of Medicine.

May 14-16.—Société française d'ophthalmologie at the Faculty of Medicine, Paris.

June 8.—Royal Society of Medicine, Section of Ophthalmology (Annual).